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THE SUBWAY'S SUCCESS.

After several days of crowding, which upset its schedule, the New York subway is settling down to business and is beginning to give the citizens of Manhattan the service to which they have been looking forward for years. The disarrangement of the service on these days was due not so much to the great number of passengers who wished to ride, as to the crowding at one or two points on the line. Then, too, although the employés of the system had been well trained, facility in handling the crowds can only come through actual experience. Another contributing cause was the exceptional precautions which were taken to prevent accident, and it is greatly to the credit of the management of the system that their efforts in this direction were so entirely successful.

As the novelty of the new road wears off and conditions become normal, and as the employés become more familiar with their work, New York will begin to realize what comfortable traveling means and will, we hope, begin laying plans so that the disastrous crowding which has been the rule on the elevated lines for some time past shall never recur.

When everything is running smoothly we believe everybody will admit the success of this great electrical undertaking. It is worth pointing out that there is no other system of traction which could be operated successfully under similar conditions.

HIGH-PRESSURE WATER POWER IN THE EAST.

California leads the world in the development of large powers with small quantities of water. One of the most striking examples of this sort, there or elsewhere, is a plant that utilizes a head of more than 1,900 feet, at which a single cubic foot of water per second is sufficient to develop 214 horse-power, if losses in pipes and wheels are disregarded. This plant is one of the group that feeds into the eighty-three-mile transmission line between the Santa Anna river and Los Angeles.

But the eastern half of the United States, though it may not be able to rival the highest heads of water powers in California, may follow with advantage the example there set by utilizing even small quantities of water wherever they can be obtained with heads above 100 feet. Even at 100 feet a single cubic foot of water per second has a working capacity of 11.2 horse-power. Thus far, in the East, the development of water power has been mainly confined to the lower reaches of the streams where volumes of water are comparatively large and heads are small. Opportunities for these developments at low heads have been in large part taken up, however, and attention is now being turned to the high lands, where many streams make up for lack of volume by the heads that can be made available for power plants.

A good illustration of the conditions that favor the development of water power at high pressure in the East may be seen in the Housatonic river which heads in Pontoosuc lake near Pittsfield, and flows south across Massachusetts and Connecticut to Long Island sound, a distance of 123 miles. In this distance the river falls 983 feet, or an average of eight feet per mile, but much of this fall is concentrated in comparatively short stretches of the river. From Pittsfield to Ashley Falls, a distance of forty-one miles, the descent of the river is only moderate, being 278 feet in all, or an average of 6.7 feet per mile. It is on this part of the stream that a great water power is to be developed for electric supply in Pittsfield, according to plans that are now under way. Moving south from Ashley Falls to Falls Village, a distance of nine miles, the river drops eighty-three feet, or 9.2 feet per mile. Between Falls Village and the mouth of Shepang river, a tributary of the Housatonic, the distance is forty-three miles and the fall of the latter stream is 517 feet, or twelve feet per mile on an average. Over a part of the last named distance, that is from Falls Village to Corn-

wall Bridge, a stretch of the river only nine miles long has a total fall of 165 feet, or 18.3 feet per mile on an average.

Here then are the physical conditions necessary for the development of water power under high heads. Along the forty-three miles of river from Falls Village to the mouth of the Shepang, the high rocky banks lie close to the stream and offer a convenient support for canals or pipe lines, so that large heads for power purposes can be created without the aid of a great dam. This is particularly true of that part of the river between Falls Village and Cornwall Bridge, where a canal, flume or pipe line nine miles in length would give a head of 165 feet without the aid of any dam whatever. At this head of 165 feet each cubic foot of water delivered per second represents a working capacity of 18.6 horse-power, from which something must, of course, be deducted for friction losses. In 1902, at Gaylordsville, Ct., which is about half way between Cornwall Bridge and the mouth of the Shepang, on the Housatonic river, the discharge of the latter was at its lowest with 543 second-feet in September, and at its maximum with 13,601 second-feet in March. Without suggesting that so extensive a development of power would be either desirable or practicable, it is interesting to note that 500 cubic feet of water per second at the head of 165 feet, the fall of the Housatonic from Falls Village to a point two miles above Cornwall Bridge, in a length of nine miles, would have a working capacity of 9,300 horse-power.

At Bull's Bridge, which is several miles south of Cornwall Bridge on this river, a dam twenty-four feet high and a canal about two miles long have been constructed so as to give a water head of 110 feet for an electric power-house. But this development utilizes only about one-ninth of the total fall of the stream, though its head is perhaps greater than that at any other large electric plant east of Niagara Falls. Along much of the length of the Housatonic its banks rise rapidly to elevations several hundred feet above the water level, so that excellent opportunities for storage are presented.

The details here presented are typical of many small rivers in the East.

THE PAY OF INSTRUCTORS.

We commented, not long since, upon the statement made by Sir William Ramsay during a recent address, that our instructors in science are paid too little. We agreed with Sir William in this, and expressed the opinion that concerted action was necessary in order to remedy this undesirable condition. We admitted that there are many able teachers who find the pleasure of teaching a better reward than the increase in pay which would come with a commercial position, but we held that this is a factor upon which it is not safe nor right to depend.

Our esteemed contemporary, the *New York Times,* takes issue with us upon this last view. It says this assertion "is a little rash, and the REVIEW's argument ignores the fact that those who are best fitted for teaching will consider several things besides larger worldly gain before they abandon their strongly indicated work of teaching. It is always well to remember, in estimating the rewards of any form of exertion, that payment often takes other forms than that of money. It might easily be questioned if it is precisely 'love of teaching' that keeps many of the first ability at that particular task. Much more probably they stick to it because a moderate salary, with the social position and the opportunities for winning the recognition they value most that go with a professional chair, seems to them preferable to the private employment that pays better only in money."

True, but in speaking of the love of teaching, we did not limit ourselves merely to the pleasure of actual instruction in the classroom, and we had all of the emoluments mentioned in mind. But the same argument can be applied to many other positions. The engineer, for example, enjoys the respect and recognition of his fellowmen. The feeling for him, it is true, is somewhat different from that for the instructor. The former is looked up to as the man who does things in a busy world, where the teacher is apt to be forgotten. The instructor who gives up his position for one in the world of applied science does not get in return merely his salary. Further, even supposing that the intangible reward of the instructor is greater than that of the man in practice, that is not sufficient reason for the difference in the material recompense which at present exists. The instructor who loves his work is surely a much better teacher than one otherwise as capable, but who would prefer to be employed in other ways, and no one would support an argument that the former should be paid less because he is in sympathy with his task.

The *Times* says further: "To be remembered, too, is the fact that instruction in science and the commercial utilization of science are two things widely different and demanding widely different abilities. We are not claiming that these or any other teachers are adequately paid. Our contention is that the teacher gets more than his salary, and that, of the more, he would certainly lose something if he went into the other field to which the REVIEW refers. This is a world of counterbalances and compensations, and despite all complaints against it, most services receive a compensation roughly adjusted to their value."

This again is true, but we can not ignore the fact that some who have been teaching for many years in high positions have given them up to go into outside work. A case came to our notice only during the past week, in which an eminent engineer who had been engaged in teaching for fifteen years or more, doing, at the same time, outside work, gave up his position as the head of an important department of an eastern institution because his outside work required more time, which could only be given it by relinquishing the other. Fortunately, instances of this kind do not happen every day, because not only are the heads of engineering departments limited in number, but they are, as a rule, older men, who do not readily change their occupations. We think, however, the poor pay offered to teachers is most felt when searching for men for minor positions in the technical schools. To the energetic young man actual practice always appeals. The smaller number of good men who are

willing to take up teaching find that advancement comes slowly, and that the temptation to give up teaching and go into other work is strong. This temptation becomes the greater as the young man's work makes a name for him and offers of enticing salaries are made. No one need be over-anxious at the present time, but neither should we fail to look out for the future, for teachers, as well as engineers, must be trained. They can not be made in a day, and unless the inducement is greater than that at present offered, there is danger that our schools may fall behind.

THE INSTITUTE PAPERS.

The two papers read at the meeting of the American Institute of Electrical Engineers on Friday, October 28, were interesting and valuable. The Gray telautograph is well known, but many of those present were not familiar with its capabilities and with the stage to which it has been brought. Recently we suggested that this instrument might find excellent use in train despatching. It is now being used for train orders in railway yards, and, as Mr. Dixon explained, it has been used apparently with much success in place of the usual ship telegraph on warships and for transmitting information and orders in coast defence service. For such purposes it would seem to be almost ideal, giving a permanent record visible to the entire gun crew; and it has, of course, no limits in the information which can be transmitted. It is interesting to note that, although the apparatus is delicate, it was in no way affected by the concussion from the heavy guns, in the somewhat rough handling to which it was necessarily subjected by those not familiar with it.

The paper by Mr. F. F. Fowle, discussing the transposition of electrical conductors, forms a valuable contribution to the Institute proceedings. Mr. Fowle gives a complete theoretical discussion, but, to the telephone engineer, the most interesting part of his paper is the discussion of practice in transposition. Not every one appreciates the importance to the telephone service of proper line construction. Betterments in transmission are apt to be credited mainly to improvements in the receiving and transmitting instruments, and better arrangements at the exchange. Mr. Fowle shows to what extent the arrangement of line conductors affects the service, and he shows, as well, how transposition is made to eliminate all cross-talk and influences from other electric circuits. The rules he gives for making transpositions have stood the test of practice, and will doubtless be of help to all telephone engineers.

It is very pleasing to learn the good progress which is being made by the building committee, in drawing up the plans for the new engineering building. As stated by Mr. Scott in the report of the meeting, these plans are now being perfected and promise to result in a building ideally suited to the purpose for which it is intended. It will undoubtedly be the finest structure for any such purpose to be found anywhere in the world, for all of which we may well be proud and should honor the liberal donor, Mr. Andrew Carnegie.

UNRECOGNIZED OPPORTUNITIES FOR ENGINEERING.

The custom of employing engineers in an advisory capacity, instead of being a universal one, is limited to those whose industrial interests, are large and whose bitter experiences, when they have attempted to do their own engineering, have taught them the wisdom of having expert knowledge to assist and direct them in all technical matters. As a matter of fact, the engineer should be called into consultation as often as the lawyer or doctor and the reason that it is not more frequently done lies largely in the fact that the general public does not know that an engineer can help it, does not realize that the selection of a motor, dynamo or engine is not a simple question of general judgment formulated in an untrained mind, without either data or the power to deduce a rational opinion from them. To the mind of the average business manager of a factory, for instance, superior technical knowledge is not required except in the matters of gravest importance. If he could realize that the services of a competent engineer will make the difference between dividends and a receiver, there would be no question but that an expert would be employed for each and every piece of work undertaken. But unfortunately for both parties, this realization seldom comes and when it does it is usually by accident. The machinery or appliances which are installed without engineering advice run, of course, and the low interest on the investment which the enterprise produces, or its final foreclosure by the sheriff, is attributed to the malign policy of the political party in power, a stringency in the money market or any cause except the rightful one—namely, failure to lay out the original equipment properly and operate it in accordance with good engineering methods.

Truly it has been said that good engineering is the application of trained common sense. Untrained common or uncommon sense can not fill the place.

As the profession becomes an older one, and takes its place among the learned professions where it rightfully belongs, and the people of the business world discover that an engineer is not necessarily either a long-haired scientific crank, wild of eye and wilder of scheme, or a thick-head whose intelligence can not grasp an idea higher than the opening of a throttle; but on the contrary, he is a skilled, alert, clear-minded man with a keen appreciation of both the technical and financial sides of every question and that he is the only type of man capable of grasping them, harmonizing them, and producing the greatest amount of dollars out of any situation, then will the engineer be busy and the nation prosperous.

The prosperity of the country now is due to the large manufacturing, railway and industrial enterprises, which from the magnitude and extent of their work must employ engineers. Their owners and managers realize the necessity of scientifically trained men. It is in the great majority of the smaller industries that such help is omitted, though it is just as much needed. How to bring their owners to see the necessity is the difficult question, and in its solution lies alike the success of both the business man and the practising engineer.

The Views of an Insurance Inspector in Regard to Electric Lighting.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The rule number 24-S of the "National Electrical Code" which says "when from the nature of the case it is impossible to place concealed wiring on non-combustible supports of glass or porcelain, an approved armored cable with single or twin conductors (see No. 48) may be used where the difference of potential between conductors is not over 300 volts, provided it is installed without joints between outlets, and the cable armor properly enters all fittings and is rigidly secured in place, or if the difference of potential between wires is not over 300 volts, and if the wires are not exposed to moisture, they may be fished on the loop system, if separately encased throughout in approved flexible tubing or conduit."

As this rule seems to be disregarded by the inspectors throughout the country, and in many instances they even go so far as to recommend and prefer placing metal conduits in wooden buildings in place of adhering to the above rule, I wish to give the following reasons why I consider it dangerous:

1. The impossibility of the proper grounding of the conduit throughout the building, and it coming in contact at different places with pipes and ironwork, is liable to cause an arc between these points.

2. It is well known that condensation takes place in the iron pipes, which causes the wire placed in them to become first damp and then dry, which will destroy in a short time the insulation of any wire.

3. It is a well-known fact that an iron-conduit system is never free from leaks (this is especially so in damp weather), which accounts for the inspectors not demanding as good an insulation test for the iron-conduit system as they would if the wires were placed on non-combustible supports of porcelain, etc.

4. It is a farce to suppose that conduits can be efficiently grounded when you are dependent on the mere contact of the conduit with the fittings, etc. This conduit lying loosely in these fittings, and as in many cases the threads of the conduit are covered with asphaltum, or some other insulation, and even if they should be so grounded, it is very doubtful if they would carry a large volume of current without heating it and causing a fire where the conduit comes in contact with inflammable material. It is very doubtful if this iron pipe would carry the current off, even if it were thoroughly grounded at one end, because the electric railroad has trouble in carrying the current from one rail to the other, and they employ bonding wires, as they have found out that the fish-plates can be very little depended on for carrying current, and as these plates have a great deal more contact surface than the joints in the pipes, it is not likely that they would meet the requirements.

5. As the conduits become moist inside, it is very doubtful if the so-called insulation or protection placed in them will prevent rust, which would damage the insulation of the wire and prevent it from being withdrawn. Another very serious effect is that of electrolysis, which is carried on through the building by these conduits. The leakage from these conduits, that are placed in a dry place, may be carried by it to some other part of the building where it is damp, which would be liable to cause a fire.

6. Going back to the old rule, that a conduit system was not considered an insulation for the wires but only a raceway, it is very doubtful if the iron conduits now applied for wooden buildings are safe after being installed for a short time, and the wires becoming defective from the causes named.

I can not help thinking that it would be well to return to the old way of wiring with porcelain tubes, cleats, etc., this class of buildings. If the wires were run on the loop system, in place of making taps in concealed places, it would overcome all the objections to this class of work.

A. B. JAMES,
Inspector Association Fire Underwriters.

Baltimore, Md., October 29.

The American Society of Mechanical Engineers.

The annual meeting of the American Society of Mechanical Engineers will be held in New York city, December 6 to December 9, inclusive. The headquarters of the society will be at the Society House, 12 West Thirty-first street, and the opening session will occur on Tuesday evening, December 6, at 9 P. M. President Ambrose Swasey will deliver the annual address, the subject being "The Achievements of the Engineer with Respect to Exact Measurements."

The second session will occur on Wednesday morning, at the hall of the Mendelssohn Union, 113 West Fortieth street, at 9.30 o'clock. This will be the business session of the convention, and the following professional papers will also be presented: "A New Hydraulic Experiment," A. F. Nagle; "A Twist Drill Dynamometer," W. W. Bird and H. P. Fairfield; "Diamond Tools," G. C. Henning.

Following this meeting luncheon will be served at the Society House, and the afternoon will probably be spent in making excursions to various power stations and points of interest. The evening of this day has been left open for the members to make their own engagements.

The third and fourth sessions will take place at Mendelssohn Union, Thursday morning and afternoon, respectively. The following professional papers will be considered: "Centrifugal Fans," A. J. Bowie, Jr.; "Computation of Values of Water Powers and Damages Caused by Diversion of Water Used for Power," Charles T. Main; "An Indicating Steam Meter," Charles E. Sargent; "Staybolts, Braces and Flat Surfaces, Rules and Formulæ," Robert S. Hale; "Condensers for Steam Turbines," George I. Rockwood.

At the afternoon session the following professional papers will be presented: "Bursting of Four-Foot Flywheels," Charles H. Benjamin; "Influence of the Connecting Rod upon Engine Forces," Sanford A. Moss; "Losses in Non-Conducting Engines," James B. Stanwood; "Power Plant of Tall Office Buildings," Sterling H. Bunnell; "Pressures and Temperatures in Free Expansion," A. Bordody and R. C. Cairncross. This paper will be presented by Charles E. Lucke. Between the morning and afternoon sessions on this day luncheon will be served at the Society House.

The usual reception for guests and friends will be held at Sherry's on Thursday evening, at nine o'clock. This will be followed by dancing and supper.

The closing session will be held at the Society House, Thursday morning, December 9, at ten o'clock. The following professional papers will be presented: "Fuel Consumption of Locomotives," George R. Henderson; "Road Tests of Brooks Passenger Locomotives," A. E. Hitchcock; "Discharge of Water with Steam from Water-Tube Boilers," A. Bement; "More Exact Method for Determining the Efficiency of Steam Generating Apparatus," A. Bement; "Forcing Capacity of Fire-Tube Boilers," Francis W. Dean.

The list of officers to be voted for the ensuing year, as presented by the nominating committee, is as follows: for president, John R. Freeman, Providence, R. I.; for treasurer, William H. Wiley, New York, N. Y.; for vice-presidents, S. M. Vauclain, Philadelphia, Pa.; H. H. Westinghouse, Pittsburg, Pa.; Fred W. Taylor, Philadelphia, Pa.; for managers, George M. Brill, Chicago, Ill.; Fred J. Miller, New York, N. Y.; Richard H. Rice, Lynn, Mass.

The secretary of the American Society of Mechanical Engineers is Dr. F. R. Hutton, 12 West Thirty-first street, New York city.

Modern High-Potential Switchboard Practice—II.

By Bertrand Perry Rowe.

FOR voltages of 40,000 or above it is rare that any great amount of current is to be carried, and insulated wires, carried on large porcelain insula-

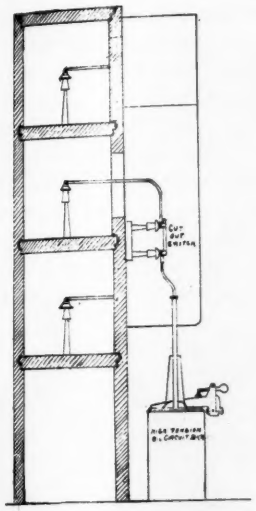


FIG. 8.—SECTION OF STRUCTURE FOR 45,000 VOLTS.

tors and well separated, are often used. The best designed stations provide compartments for these high-tension conductors to isolate them, but many rely on the air space only. Fig. 8 shows a section of such a structure for 45,000 volts.

In such installations as have been described, the potential transformers are connected to great sources of power and it becomes necessary to provide against possible damage to the system if one of them should blow up. It is therefore customary with the best practice to protect them with enclosed fuses, each fuse and transformer being isolated in its own individual cell, in keeping with the principle of isolation which has been described heretofore. If the cells are open in front, it is imperative that they be so located as not to damage any other apparatus by means of arcing or flashing in case the fuses or transformers should burn out.

Having described in a general way the structural work involved in a modern high-tension power station, it will be in order to describe the various forms of apparatus which are commonly used therewith, and their functions.

Fig. 9 shows a front view of the Westinghouse type "C" circuit-breaker, with the doors removed. It will be noted that it is so constructed that each pole is in a separate compartment and all of the live metal contacts are entirely immersed in oil.

The stationary contacts, of which there are two to each pole, are mounted in large fixed insulators which are suitably supported from the top slab of soapstone by means of insulating supports. Heavily insulated conductors are attached to these terminals and are brought out in the rear of the circuit-breaker through special porcelain bushings cemented into soapstone blocks in separate compartments. This can be seen by reference to Fig. 10.

The moving contacts in the circuit-breaker are operated and supported by

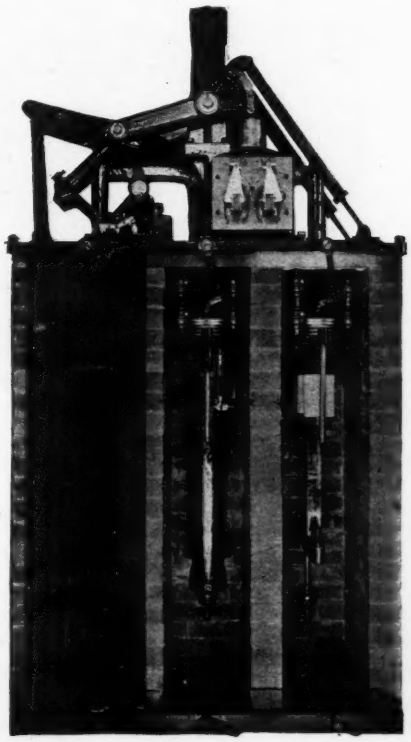


FIG. 9.—FRONT VIEW OF OIL CIRCUIT-BREAKER.

long wooden rods which are secured at the top to a cast-iron cross-bar. The cross-bar is raised by a pair of powerful electro-magnets through a system of levers which give it a parallel motion. When the switch is closed the levers are locked by a toggle. To trip the breaker, a tripping coil is used which operates from direct current and throws the toggle lock over the centre, and the breaker quickly opens by its own weight. It will be seen that this method prevents the possibility of gravity accidentally closing a breaker.

The moving contact is a copper cross-bar carrying a contact on each end. When the breaker is closed the cross-bar bridges the stationary contacts above mentioned. A cylindrical contact in the centre of each stationary contact makes the final break, and may be replaced when worn out.

The contact just mentioned acts as a shunt to prevent burning the main contacts. It will be seen that the arc is broken by two breaks in series.

The oil tanks are locked in position and may be easily removed by a can-lifter, supplied with the circuit-breaker. All sediment settles at the bottom of the tanks, and the contacts, being inverted, are thus free from dirt from this cause. Gauges are provided on the tanks for inspecting the oil level.

A heavy casting supports the closing mechanism which is self-contained, and this feature allows of the breaker being set up and adjusted independently of the structure so that when installing the breaker no difficulty is experienced in lining up parts or adjustments.

The circuit-breaker has a form that readily adapts it to a great variety of combinations in connection with bus-bar structures, as has been shown in the illustrations.

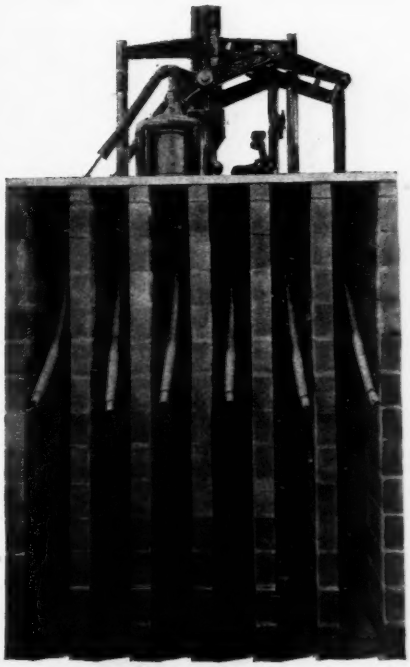


FIG. 10.—REAR VIEW OF OIL CIRCUIT-BREAKER.

It will be seen that this is truly a circuit-breaker, and as it can be supplied with relays operated from current transformers to open an overload or reverse

current, its action may be either non-automatic, as when operated by the attendant, automatic for reverse current, or automatic for overload, either with or without a time-limit relay or inverse time-limit relay.

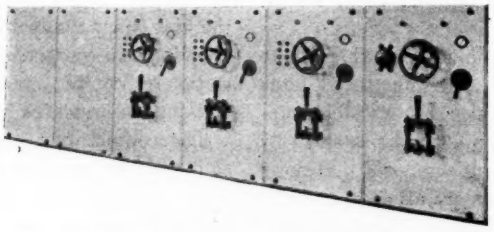


FIG. 11.—GENERATOR CONTROLLING PANELS.

The closing and tripping coils are operated by direct current from any direct-current circuit and are usually wound for 125, 250 or 500 volts, as these are the most common voltages.

The standard circuit-breaker manufactured by the General Electric Company is operated by a small motor, the motor in turn being controlled by the operator and supplied with direct current, either from the exciter circuit or from a storage battery where low-potential current is not available.

For the generating station with high-tension, electrically operated switchboard apparatus, the equipment usually required in addition to the oil circuit-breakers and bus-bars is as follows:

Apparatus for use with the generators—generator instrument switchboard, generator controlling switchboard, field rheostats and field switches, direct-current exciter switchboard.

Apparatus for use with the feeders—feeder instrument switchboard, feeder controlling switchboard.

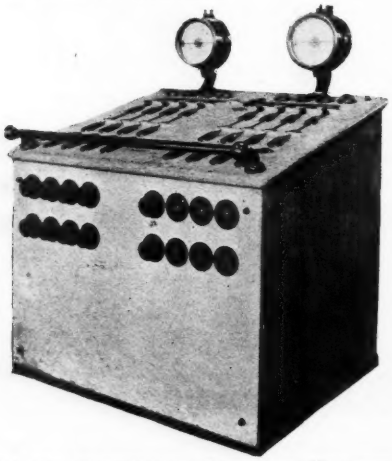


FIG. 12.—CONTROLLING DESK AND MINIATURE BUS-BAR.

General apparatus for entire station—one set of station instruments such as voltmeter, synchroscopes, etc.; station static ground detectors if required.

CONTROLLING AND INSTRUMENT SWITCHBOARDS.

Under this head we will consider the installation of control switches and accessories that control the electrically operated oil switches. The apparatus can be mounted on the face of a switchboard panel, together with the instrument, where the system is simple and an inexpensive arrangement is desired.

Fig. 11 shows a photograph of a set of panels which is installed in the station of the St. Joseph & Elkhart Power Company for the generator controlling apparatus. The generator instruments for use with these central panels are located on small panels supported side by side some distance above the controlling panels, leaving a clear space through which the operator has a view of the station. Most large stations, however, have the generator control apparatus mounted on controlling desks or pedestals.

Another feature of a great many controlling outfits is the use of miniature bus-bars with lamps or indicators in the circuits. By means of these the entire main station connections are mapped out in miniature on the controlling desk, and if the indicators or lamps are placed in the miniature circuits, the switching operations can be seen to take place when the operator moves his controlier exactly the same as they occur in the main circuit, so that the whole outfit appears to represent the actual condition of things. Some of these indicators have small copper strips on their dials that actually seem to bridge over the gaps when the oil circuit-breakers are closed, and the effect is very realistic.

As a matter of practical value, however, it seems to be the consensus of opinion among central station men that after the operator has once obtained a good working knowledge of his plant, the miniature system is of little use to him, and is only interesting to explain to visitors the operation of the switching system. My own opinion is that a good suggestive arrangement of the control apparatus, with the omission of the miniature bus-bar system, answers the purpose just as well; is apt to be less complicated, and is more compact. It would be much cheaper to make a drawing to take the place of the miniature bus-bars, frame it, and hang it in a convenient place as an explanation of the system to the uninitiated.

FIG. 13.—CONTROLLING DESK AND MINIATURE BUS-BAR.

Figs. 12 and 13 show some controlling desks with miniature bus-bars and indicators as just described.

One of the disadvantages of the desk as shown is that in order to get the proper arrangement of bus-bars and indicators, the complete station connections must usually be laid out in miniature, and if only part of it is installed, the whole desk is generally made and the positions drilled for future apparatus plugged up with temporary hard rubber plugs.

When the desk type switchboard is used, it is usually placed directly in front of the instrument switchboard and the operator has his control apparatus arranged as nearly as possible opposite his respective instrument panels. A view of such an instrument switchboard is shown in Fig. 14.

It will be seen that the controlling desk

is not like a panel switchboard. to be indefinitely extended, and does not readily lend itself to future extensions without alteration, unless some arrangement is arrived at, so that it can be built and installed in sections.

The arrangement of control apparatus into groups, so that units of control can be handled the same as panel switchboards, seems to be the ideal. Nearly every large installation starts with a few generating units and increases as the demand for power increases. To meet the demand for such installations, there has been designed a control pedestal which seems to embody all the features that are desirable. Fig. 15 gives a good idea of this pedestal when used to control a generator circuit. It generally contains controllers, indicators, and lamps for the oil circuit-breakers, synchronizing plugs and lamps, voltmeter plug, electrically operated rheostat controller, a controller for the engine governor to change the speed in synchronizing the generators, and the controlling device to open and close the electrically operated alternating-current generator field-switch. The pedestal presents a very neat and attractive appearance and only occupies a floor space about sixteen inches square. It is of such a height that the operator can easily look over the top of it.

For use with this controlling pedestal instrument posts are being installed. One of these for a set of generator instruments is shown in Fig. 16. The post is usually set in the edge of the switchboard gallery

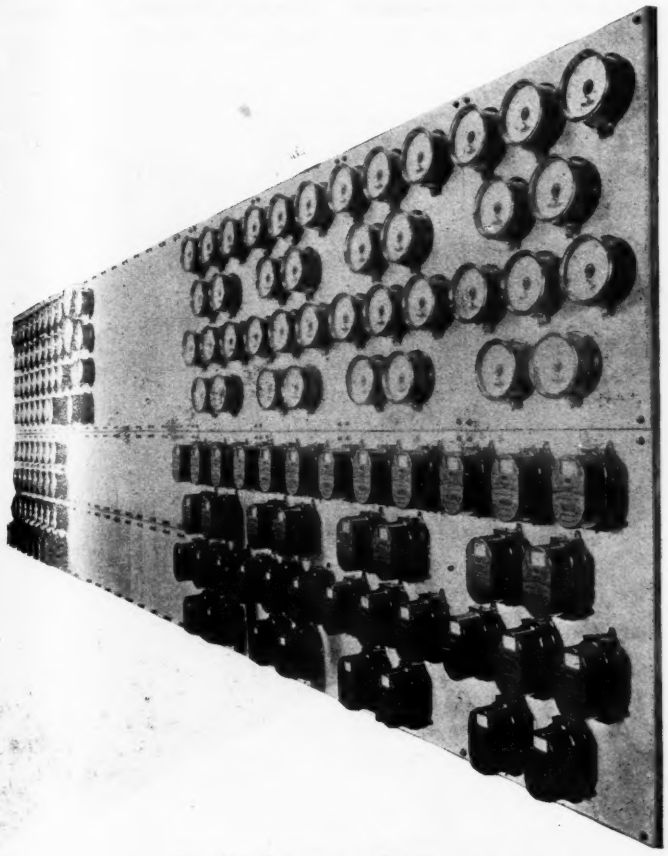


Fig. 14.—Instrument Switchboard.

Fig. 16.—Operating Instrument Post.

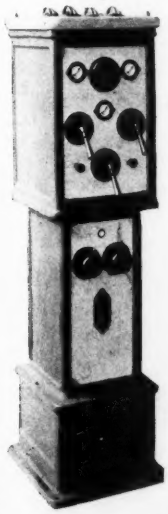


Fig. 15.—Controlling Pedestal.

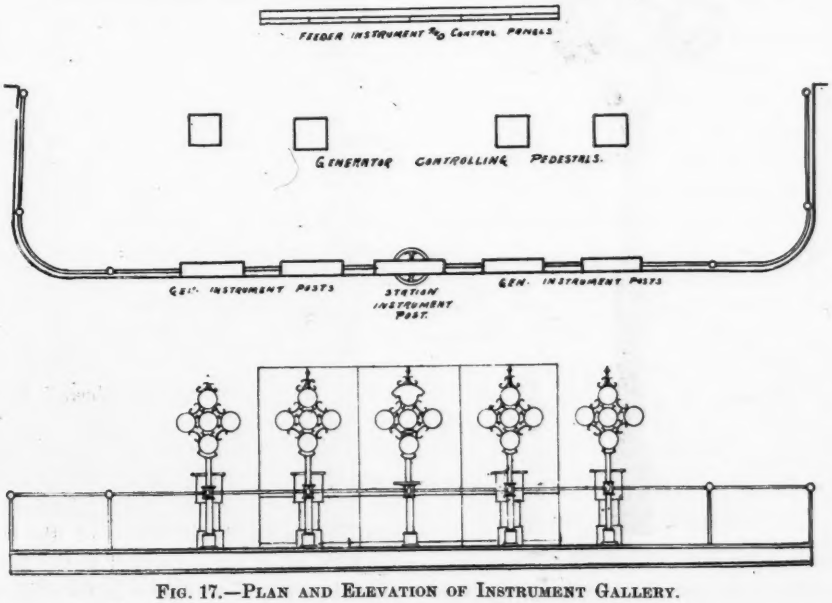


Fig. 17.—Plan and Elevation of Instrument Gallery.

with the meters facing the operator who stands at the control pedestal and faces the station, having an unobstructed view of the generators he wishes to control. This is just the reverse of the case of the controlling desk, where the operator must turn his back on the station in order to see his instruments, which are located on the instrument switchboard.

The condition of affairs may be readily seen by reference to Fig. 17, which shows a gallery with pedestals and instrument posts. With this arrangement the feeder switchboard is located just in the rear of the controlling pedestals so that the operator can be within easy reach of all of the control apparatus.

The usual method of controlling feeder circuits is to place the controllers on the switchboard directly beneath their respective feeder instruments. This on the whole seems to be the simplest way and is the scheme used in the illustration, Fig. 18.

In conjunction with the instrument posts shown in Fig. 16 there is being used a station instrument post which holds the voltmeters and synchroscopes. This is shown in Fig. 19, and usually stands in a central position in the gallery, and the whole top is arranged to swivel, so that the instruments may be seen from any point in the gallery. They also have a

FIG. 19.—INSTRUMENT POST.

similar post on which a large synchroscope three feet or more in diameter may be mounted, the correct position on the dial for synchronizing being indicated by a lamp, while a lamp on the pointer of the instrument shows by its position on the dial whether the machine is running fast or slow or is in synchronism. This, of course, can be made to work in parallel with the synchroscope in the gallery.

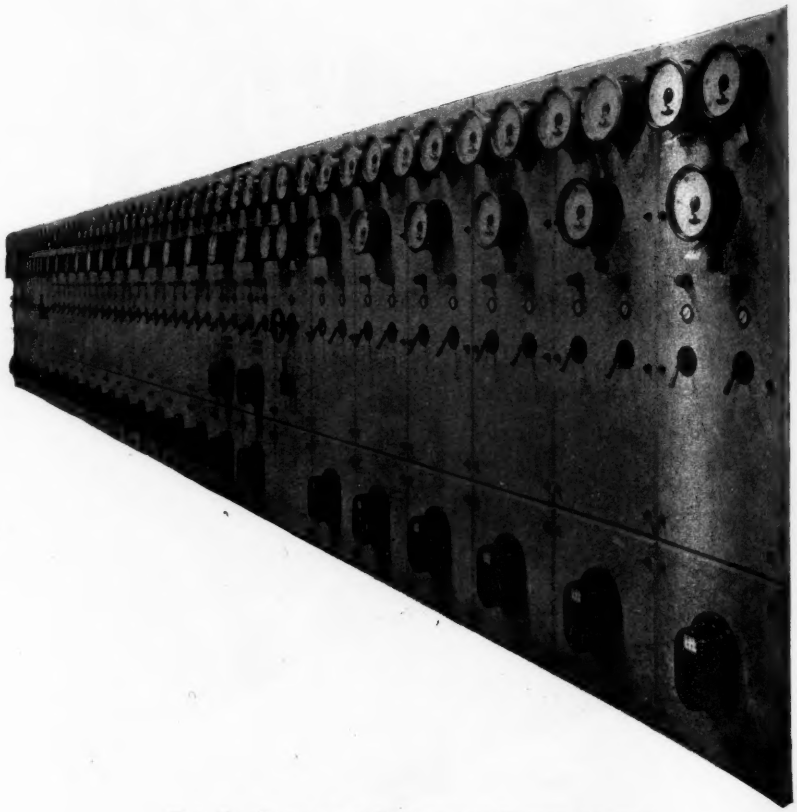


FIG. 18.—PANELS FOR CONTROLLING FEEDER CIRCUITS.

FIELD RHEOSTATS AND ALTERNATING-CURRENT FIELD SWITCHBOARD.

If the generator control apparatus is located on a panel, the field rheostats can be very conveniently operated by means of a hand-wheel on the panel directly geared to the face-plate of the rheostat by gearing or chain and sprocket.

If the rheostats are electrically controlled from a distance, however, the face-plates of the rheostats have a small motor geared to the contact arm, the motor being controlled from the operating platform. In such a case, the field switches must usually also be electrically operated.

Fig. 20 shows a switchboard having electrically operated field rheostats and field switches which are controlled from the operating gallery, the switchboard shown being usually located immediately in front of the resistances which are connected to the face-plate, in some suitable place in the station.

DIRECT-CURRENT EXCITER SWITCHBOARD.

The switchboard for control of the exciters is sometimes placed in the operating gallery, when this is not too remote from the machines. In other cases it is placed on the station floor as near as convenient to the exciters. The switchboard is usually a typical direct-current switchboard, and while the most serviceable ones are finished in black, a large number of stations are using blue Vermont marble.

Fig. 21 shows a typical exciter switchboard for heavy capacity exciters. It will probably be needless to observe that the circuit-breakers shown are non-automatic, being only used to trip by hand when the circuit is to be interrupted in order to prevent the arc from burning the switch. Some station managers prefer reverse-current circuit-breakers in their exciter circuits, but the usual practice is to omit protective devices.

STATION APPARATUS.

In addition to providing for station voltmeters, synchroscopes and wattmeters, either on panels or with the instrument post shown in Fig. 19, it is often necessary to install static ground detectors. These are usually operated from condensers so located that the wiring can be short, and the conductors properly separated and far enough from neighboring metal so as not to interfere with the operation of the instruments. This end is best accomplished in most cases by installing the ground detectors on the sta-

tion wall or on suitable supports near the condensers in case it is difficult to properly run the leads to the operating gallery.

While the station indicating instruments may be provided for as described previously, or on swinging brackets attached to a panel switchboard, it is often an advantage to be able to locate station recording apparatus such as integrating wattmeters, recording ammeters, etc., in a separate switchboard removed from the indicating meters, especially when the operating gallery is small. Such a recording switchboard is usually only consulted at intervals, and when it is removed from the operating gallery it leaves nothing but indicating meters for the observation of the station operators, and simplifies the control gallery equipment. In most cases, however, except in some very large installations, the recording and indicating meters are provided for along with the indicating meters in the operating gallery.

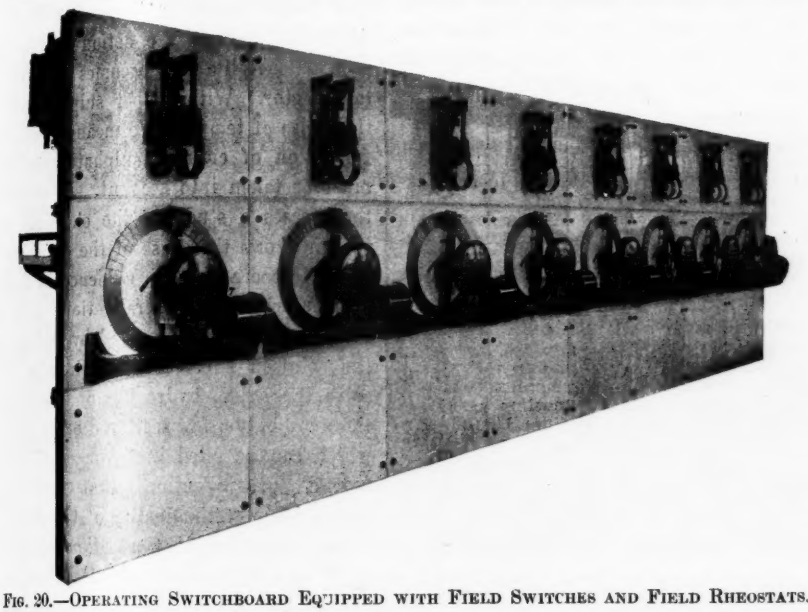


FIG. 20.—OPERATING SWITCHBOARD EQUIPPED WITH FIELD SWITCHES AND FIELD RHEOSTATS.

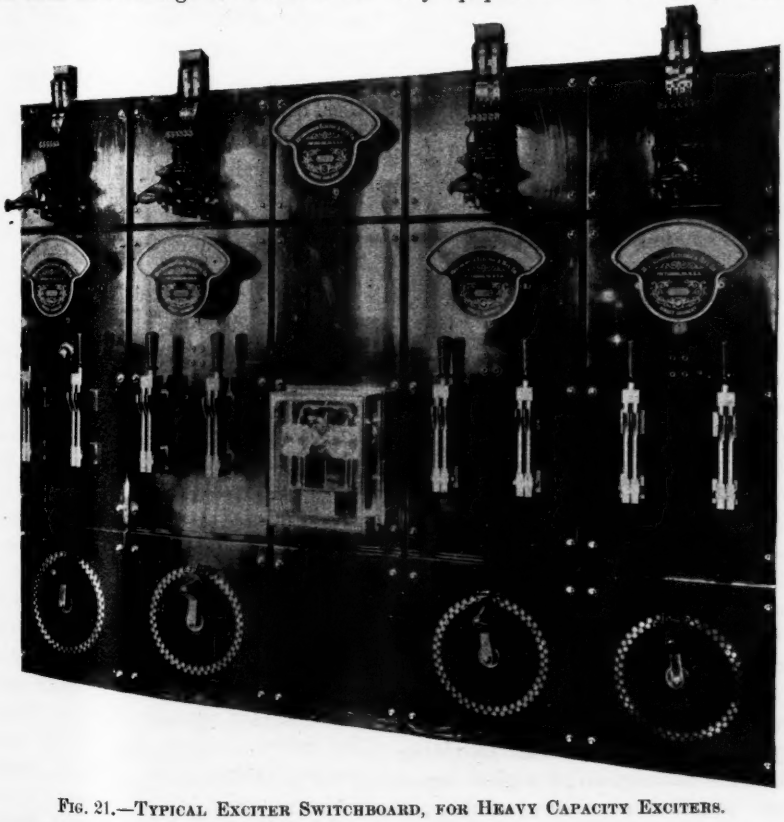


FIG. 21.—TYPICAL EXCITER SWITCHBOARD, FOR HEAVY CAPACITY EXCITERS.

Official Catalogue of Exhibits at the Universal Exposition, St. Louis, Mo., 1904.

The official catalogue of exhibits at the Universal Exposition, St. Louis, 1904, published by the Official Catalogue Company for the committee on press and publicity, under the supervision of the director of exhibits, is a most ambitious volume. The work is divided into sections, as follows: department A, education; department B, art; department C, liberal arts; department D, manufactures; department E, machinery; department F, electricity; department G, transportation; department H, agriculture; department J, horticulture; department K, forestry; department L, metallurgy; department M, fish and game; department N, anthropology; department O, social economy; department P, physical culture, and department R, live stock. The classifications are very accurate and complete in every detail. Each division has been compiled under the direction of the director or the chief of the division. The work comprises some 2,000 pages altogether, and presents a compact, classified index and compendium of the achievements and ideas of society in all phases of its activities.

The preface is written by Frederick J. V. Skiff, director of exhibits, and the book has been produced under the management of Mr. Stephen W. Bolles.

The Souvenir of the St. Lawrence River Power Company.

The St. Lawrence River Power Company has issued a handsome souvenir descriptive of its power plant at Massena, N. Y. This description includes a sketch of the town of Massena, and describes a few of the industries already using power from this installation. Illustrations are shown, giving the geography of the country and the progress of the work. There are also a number of illustrations of views in the town of Massena and its environs.

Copper Shipments to the United States from Mexico.

The exports of copper into the United States from Mexico for the first six months of the year 1904 aggregated 19,948 tons. During the same period in 1903 the exports from the same country were 9,621 tons.

THE CHEMISTRY OF ELECTROPLATING.[1]

BY PROFESSOR WILDER D. BANCROFT.

Although some results have been obtained by Mylius, Foerster, Glaser, Burgess and others, a glance at the recent text-books on electrochemistry will show how far we still are from any consistent theory of electroplating. The reason for this is to be found in our neglect of the chemistry involved. The electric current is merely one agent for bringing about certain chemical reactions; but this is often overlooked and many of us consider a decomposition by means of electricity as much more mysterious than a decomposition by heat, for instance. I hope to show that a study of chemical reactions and chemical analogies will at least give us the outlines of a theory of electroplating.

When we speak of a good metallic deposit we may mean good from the point of view of the analyst, the refiner, or the plater. The analyst must have a deposit of pure metal in a weighable form but that is all. The refiner must have a coherent deposit of pure metal, except in the case of silver. Neither the analyst nor the refiner cares about the smoothness of the deposit, so long as no trees are formed. The plater must have an adherent smooth deposit which will burnish to an apparently amorphous surface. In the preliminary discussion we will rule out the plater and will call a deposit good when it is pure and coherent. Afterward we can consider the further problem of the production of a very fine-grained deposit. Since there are very few data for anything except aqueous solutions, we will consider these only, though the general principles are equally applicable to all solvents.

When working with moderate current densities a bad deposit is practically always due to the precipitation of a non-metallic solid with the metal. When one of the single salts in the bath is sparingly soluble, as with the cyanides, this salt may precipitate. In most cases, however, the trouble is due to the presence in the deposit of oxygen either as oxide, hydroxide or basic salt. Whatever will dissolve the salt readily under the conditions of the experiment will prevent its deposition, by definition, and should therefore improve the quality of the deposit. This has been recognized for zinc by Mylius and Fromm[2] and by Foerster and Gunther.[1] It has been put in a more general form by Glaser.[2]

I have made a list of the more important additions recommended in the refining, analysis, or plating of zinc, nickel, lead, tin, copper and silver. These are given in table i.

TABLE I.

ZINC.	TIN.
Sulphuric acid	Sulphuric acid
Potash	Potash
Ammonium chloride	Sodium pyrophosphate
Ammonium sulphate	Potassium carbonate
Aluminum sulphate	Acid potassium tartrate
Potassium cyanide	Potassium cyanide
Acid potassium oxalate	
NICKEL.	**COPPER.**
Sulphuric acid	Sulphuric acid
Ammonia	Ammonia
Ammonium salts	Alkaline tartrate
Potassium cyanide	Ammonium oxalate
Sodium bicarbonate	Potassium cyanide
Sodium bisulphite	Sodium bisulphite
LEAD.	**SILVER.**
Acetic acid	Nitric acid
Potash	Ammonia
Fluosilicic acid	Potassium cyanide
Sodium nitrate	Potassium iodide

All the substances under zinc dissolve zinc hydroxide. The first four under nickel dissolve nickel hydroxide; the sodium bicarbonate probably serves to keep the acidity constant; while the sodium bisulphite occurs only in solutions containing free ammonia. All the substances under lead dissolve lead hydroxide. Stannous and stannic acids are soluble in sulphuric acid, in potash, and in a so-called sodium pyrophosphate solution; potassium carbonate is added only to neutralize an excess of free acid in stannous chloride solutions; while the cyanide and tartrate seem to be of very little value, unless perhaps at the anode. Under copper everything dissolves the hydroxide except sodium bisulphite and this is added to cyanide solutions to prevent loss of cyanogen when the copper changes from the cupric to the cuprous form. All four substances under silver dissolve freshly precipitated oxide; in addition ammonia dissolves silver chloride, while silver cyanide and silver iodide are soluble in potassium cyanide and potassium iodide, respectively.

It is thus clear that there is a simple rational basis for many of the solutions in actual use. It must be kept in mind, however, that the rate of solution is more important than the actual solubility. Thus it is not easy to get a good deposit from an alkaline zincate solution at twenty degrees, whereas it is a comparatively simple thing to do this at forty degrees because the caustic soda reacts with zinc oxide or hydroxide much more rapidly at this temperature. It does not follow from this that a higher temperature would necessarily be even better. At ninety degrees the action of caustic soda on metallic zinc becomes an important factor. With copper sulphate solutions rise of temperature means increased formation of cuprous sulphate and this must be taken into account. In each of these cases a study of the chemical reactions shows the cause of the difficulty.

While there is much evidence in favor of Glaser's first generalization, that a metallic deposit is improved by adding to the solution substances which will dissolve the oxide, hydroxide or basic salt, there are only a few scattered experiments which can be cited in favor of Glaser's second generalization that reducing agents improve the quality of the deposit. Glaser[1] observed that addition of pyrogallol or hydroquinone to a lead bath improved the deposit of electrolytic lead. Engels[2] states that the addition of hydroxylamine makes it possible to use higher current densities in the analysis of copper. It is believed that tin salts in solution improve the quality of a copper deposit[3] and it is known that ferrous salts are not disadvantageous. Good deposits of many metals are obtained from cyanide solutions and part of the effect, though certainly not the whole of it, may be due to the fact that potassium cyanide is a reducing agent. It is also possible that the merits of a tartrate solution may be due in part to the formation of reducing agents by oxidation at the anode.[4] In some experiments made at Cornell we have found that hydrazine improves the electrodeposition of cobalt and that resorcin has a slightly favorable effect with zinc but apparently not with tin. The negative result in this last case may be due to the reducing power of the tin solutions. These instances will suffice to show that we do not yet know definitely how much influence a reducing agent has or how it varies with varying conditions. Since none of the reducing agents in question will reduce the oxide to metal, it seems very probable that the effect of the reducing agent may merely be to prevent oxidation by dissolved oxygen.

[1] Presented before section C, electrochemistry, International Electrical Congress, St. Louis, 1904.

[2] *Zeit. Anorg. Chem.* 9, 144 (1895)

[1] *Zeit. Elektrochemie*, 5, 16 (1898); 6, 301 (1899).

[2] *Ibid*, 7, 365, 381 (1900).

[1] *Zeit. Elektrochemie*, 7, 381 (1900). *Cf.*, Elbs and Rixon. *Ibid*, 9, 287 (1903).

[2] Smith. "*Electrochemical Analysis*," 62.

[3] Borchers. "*Elektrometallurgie*," 193.

[4] Luther. *Zeit. Elektrochemie*. 8, 647 (1902); Schilow, *Zeit. Phys. Chem.*, 42, 646 (1903).

If so, the effect should disappear in a vacuum or in an atmosphere of nitrogen. It has not yet been possible to try this experiment.

We have next to consider the effect of higher current densities. When solutions are not stirred we soon reach a point at which an ever-increasing current density causes a bad deposit. This change in the quality of the deposit is always accompanied by an increased evolution of hydrogen, and it is usually believed that the evolution of the hydrogen is the cause of the deposit going bad. This can not be the whole truth because hydrogen is evolved freely during electrolytic analyses and yet the deposit remains good. Further, the so-called critical current density varies enormously with the size, shape and distance apart of the electrodes, and also with the size and shape of the containing-vessel, so that the data obtained by any one man usually can not be duplicated by others. The most important factor is the rate of stirring. If we rotate a smooth copper, zinc or nickel cathode with sufficient speed it is by no means certain that there is any current density at which the deposit goes bad. With tin there does seem to be a limiting density, but this is very possibly due to the formation of stannic salts in solution. It is intended to study this question in detail.

When a deposit becomes sandy or changes to a black powder, the polarization shows that there has always been the formation of a dilute solution at the cathode. In most cases this leads to the precipitation of an oxide or basic salt with the usual disastrous results. It is still an open question whether this is always the case. Foerster and Seidel[1] say that sandy deposits of copper are not due to the presence of oxide. If this statement is correct, we shall be forced to the assumption that the badness of the deposit is due to the pulsating or intermittent precipitation of hydrogen as a result of the intermittent formation of a surface film impoverished as to metal. This explanation does not appeal to me personally and I prefer to believe for the present in the oxide formation even if I have to account for the apparent absence of hydrogen by assuming a reduction to metal after the harm has been done.

Hydrogen may easily be indirectly the cause of a bad deposit. If hydrogen adheres as bubbles to the cathode, the deposition of the metal will become uneven and we shall have conditions favorable for treeing. A trouble of this sort can be cured chemically by adding an oxidizing agent to remove the hydrogen. It is known that copper solutions containing nitric acid will stand much higher current densities than will those acidified with sulphuric acid. It is clear that the prevention of hydrogen by means of an oxidizing agent may lead to the oxidation of the metal in which case we are out of the frying-pan into the fire. Foerster and Gunther[1] had difficulties with hydrogen bubbles during the precipitation of zinc. They show that such oxidizing agents as chlorine and ammonium persulphate prevent the appearance of hydrogen without causing the formation of zinc oxide. Such oxidizing agents as hydrogen peroxide and ammonium nitrate prevent hydrogen evolution but were worthless because they oxidized the zinc.

An oxidizing agent could probably be used to prevent occlusion of hydrogen by nickel, for instance. It is quite likely that the disadvantages would outweigh the advantages. In that case it would be better to approximate the same result by varying other conditions. The favorable conditions would be: a concentrated solution to ensure a good deposit; a high temperature to lower the absorption coefficient; a nearly neutral solution to increase the decomposition voltage of hydrogen; and a high current density to give a fine-grained metal. For any given rate of stirring we should expect a limiting current density beyond which deterioration would occur. With increasing current density we get a finer deposit but there is also an increasing tendency to precipitate hydrogen and it is necessary to strike a balance between these two. All these conditions have been found experimentally for nickel by D. H. Brown[2] with the one exception that he finds a large addition of sodium chloride advantageous.[3] The reason for this is not clear.

Having considered the conditions for getting a good deposit from the refiner's point of view, we can now take up the question from the point of view of the plater. The problem is now as to the conditions under which the deposit is composed of very small, microscopic crystals.

When we precipitate a salt by chemical means we get larger crystals, the slower the precipitation and the higher the temperature. We should therefore expect that an electrolytic deposit will be coarser the lower the current density and the higher the temperature, provided all other conditions are held constant. The conclusion as to the current density is confirmed by all experiments. The case of the temperature change is a little more complicated because we may have hydrolysis and increasing acidity or alkalinity; we may have increased solvent action; and we may have a displacement of equilibrium as with copper sulphate. The effects due to these changes will, of course, superimpose themselves on the public temperature effect and mask or even reverse it. In some experiments made in my laboratory Mr. Snowdon found that the deposit from an acidified copper sulphate solution became coarser as the temperature was raised from twenty degrees to forty degrees and to seventy degrees. A similar result was obtained with a strongly acid zinc sulphate solution and with a lead bath. With nickel ammonium sulphate solution the effect of temperature on the crystalline structure of the deposit was too small to be detected. With a zinc sulphate solution which was only slightly acid, the deposit was more finely grained at forty degrees than at seventy degrees; but the deposit at twenty degrees was coarser than either of the others. I suspect that at twenty degrees the slight acidity had no appreciable effect on the deposit, while it became an important factor at forty degrees. This hypothesis is confirmed by the other experiment in which a more acid solution behaved normally.

For a given current density, temperature and salt solution, we should expect a coarser grained deposit the more concentrated the solution. This has been found to be the case in experiments with zinc sulphate and sodium zincate solutions. Since the potential difference between the metal and the solution is less the more concentrated the solution, it seems probable that this is an important factor when we change from one solution to another. Other conditions being the same we shall get the smallest crystals, the greater the potential difference between the metal and the solution. This is the recognized explanation for the excellent character of the deposits from cyanide solutions.

A natural corollary from this last is that the deposit will be more finely crystalline, the greater the solvent action of the solution. This accounts for the small crystals that are obtained from an acid copper sulphate solution or from one containing nitric acid. This conclusion, of course, holds only within the limits for which we get a good deposit. The con-

[1] *Zeit. Anorg. Chem.*, 14, 125 (1897).

[1] *Zeit. Elektrochemie*, 5, 22 (1898).

[2] *Electrochemical Industry*, 1, 348 (1903).

[3] Cf. Pfanhauser, *Zeit. Elektrochemie*, 8, 594 (1902).

verse of this would be that reducing agents should increase the size of the crystals. Mr. Snowdon has found that addition of formaldehyde to a copper or a zinc solution does make the deposited metal more coarsely crystalline. Resorcin has a similar effect with zinc. It will be difficult to get conclusive evidence on this point because many reducing agents form complex salts and the effect due to this may easily overbalance the other. If the reducing agent acts only to remove dissolved gases, its effect on the size of the crystals would probably be negligible.

The addition of glue or similar substances to a solution tends to make precipitates come down in a colloidal form. Following out this analogy we should expect to find that addition of glue or similar substances to an electrolytic bath would decrease the size of the metal crystals, the limiting concentration being that at which the added substance causes a bad deposit owing to its chemical properties. It is known that the success of the Betts process for refining lead is due in part to the action of glue in preventing trees. We have found that the addition of ten grammes of glue per litre of acidified copper sulphate solution improves the quality of the deposit from the plater's point of view.

One final point is of importance to the plater, the adhesion of the deposit. It has been suggested that an adherent plating deposit can be obtained only when the two metals can combine to form compounds of solid solutions.[1] This has also been denied.[2] While I have not yet made any experiments myself, I feel certain that Burgess is right and that this is purely a question of chemistry. The surface between two metals is a thin weld and it must show the same strength no matter how it has been made. In other words, the adhesion of an ideally made electrolytic deposit will approach that of a casting having the same size of crystals. Presence of grease, of air bubbles, or of occluded mother liquor will impair the contact and weaken the joint. If the metal be deposited in a state of strain, the break will come at the weakest point. These are matters of general knowledge in making welds or castings and they are just as much first principles in electrolytic work. No one seems to have been struck by the absurdity of the statement, to be found in most books on plating, that nickel can not be plated on nickel because it will not adhere. If this were true it would not be possible to deposit more than an infinitesimally thin film of nickel electrolytically. While it requires a higher voltage to deposit nickel than copper, nickel does not precipitate copper to any appreciable extent when immersed in a copper sulphate solution. The nickel becomes passive and is probably covered with a thin film of oxide. What people mean is that an "active" nickel containing hydrogen will not adhere to a "passive" nickel. There is nothing surprising or mysterious about this.

The alleged rusting of iron, when plated with nickel in a chloride instead of a sulphate solution, if really true, is purely a chemical phenomenon and rests on the different behavior of occluded chloride and sulphate solutions. If the distinction is a real one, special experiments would soon show whether the freedom from rust in sulphate solutions is due to the iron becoming passive or to the formation of an insoluble basic salt.

The general results of this paper are:

1. A bad deposit is always due to the precipitation with the metal of some salt or non-metal.

2. Addition to the solution of anything which will dissolve this salt or non-metal will tend to prevent its precipitations and to improve the quality of the deposit.

3. Any beneficial action of a reducing agent is probably due to the removal from the solution of dissolved oxygen.

4. A fine grained deposit is favored by high-current density and potential difference, by acidity and alkalinity, by low temperature, and by colloids.

5. Solutions containing oxidizing agents appear to yield small crystals while larger crystals are obtained from solutions containing reducing agents.

6. The adherence of deposits rests on the adhesion of the two metals.

The discussion has been incomplete. The formation of "trees" has only been touched upon and the question of "bright" deposits has not been raised. All of the generalizations rest on insufficient evidence. On the other hand, the consideration of the chemistry of electroplating has given us a working hypothesis which can be tested experimentally.

[1] Kahlenberg, *Electrochemical Industry*, 1, 201 (1903).
[2] Burgess, *Ibid*, 204.

William Barclay Parsons.

[*From the New York Press.*]

No one is trying to deprive John B. McDonald of one iota of the credit that is due him as a successful contractor who superintended the construction of the subway; but it looks as if nearly everybody has forgotten that there is such a man as William Barclay Parsons, the young aristocrat whose masterful mind planned the entire underground system. Yes, Parsons is young at forty-five. His blood is the bluest of the blue. He has the fanatical eye of genius. Those who knew him at Columbia, class of '79, were convinced that he was fated to achieve. Even his tip-tilted nose had an impressive effrontery, a saucy assurance indicative of boldness of action.

Perhaps protégé is too strong a word, for Parsons needed neither care nor protection, but that he was under the wing of Calvin S. Brice is certain to the extent that Brice was his friend and patron, picking him out of a great number of engineers to go to China in the interest of his railroad syndicate. Brice never blundered in the selection of men. Perhaps he had more to do with the appointment of Parsons as chief engineer of the rapid transit commission than any other single man. Parsons used to trim his beard to a point and looked like a cadaver. There were waste places in his whiskers on each side of his imperial. To-day what was the French point is a rounded mop, such as Sousa boasts; but Parsons's beard is fretful, like his hair. His head is a splendid dome, homely and utterly unbecoming, as the domes of all great men are. When nature planned him she said, "Brains before beauty."

Roosevelt selected Parsons for the Panama canal commission, and there are few keener judges of ability than the President. He chose the subway engineer because he recognized in him the most distinguished transportation expert in the world. Great Britain admitted his ability when he was made an advisory member of the Royal English commission which is to solve the problem of London's passenger traffic. Parsons should be addressed as "General," for was he not chief of engineers of the National Guard, with the title of brigadier-general?

The Official Souvenir of the New York Subway.

The Interborough Rapid Transit Company has issued an official souvenir commemorating the opening of the New York subway. This volume is splendidly worked up, the illustrations and text being remarkably well executed. In addition to twelve chapters, which detail the work of construction and equipment, showing many fine illustrations, there is an introductory chapter which deals with the history of the subway and the formation of the Interborough Rapid Transit Company and the Rapid Transit Subway Construction Company.

Chaux-de-Fonds—Locle Hydraulic Plant.

By C. L. Durand.

AMONG the Swiss hydraulic plants of special interest is the station which is located on the river Areuse, together with the two substations at Chaux-de-Fonds and Locle where the energy is transformed and distributed to the secondary mains. The present plant is one of the few in Europe which uses the high-potential direct-current system with generators and motors in series. This method, which has been so successfully applied by M. Thury in the long-distance line from St. Maurice to Lausanne, has been adopted in the present case, and it presents some peculiarities in its methods of working which are worthy of attention.

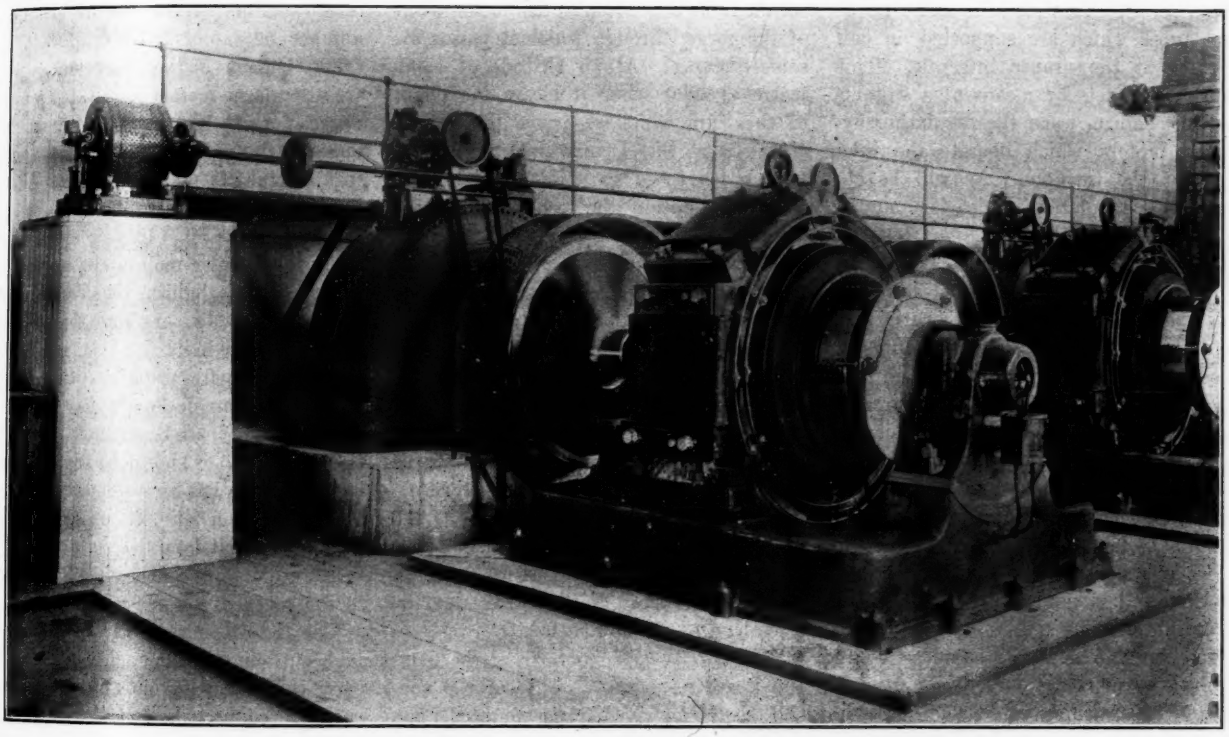


FIG. 1.—THE COMBE-GAROT HYDROELECTRIC PLANT, SHOWING THE SERIES GOVERNOR.

The hydraulic power is furnished by the Areuse, a mountain stream lying in the Jura region. It has its source in the Val de Travers and then follows the gorges from which it empties into lake Neuchatel, making a total fall of 1,100 feet on a distance of twenty-five miles. The present hydraulic plant utilizes the third fall of 300 feet, which belongs to the communes of Chaux-de-Fonds, Locle and Neuchatel.

The generating station is located on the Areuse at Combe-Garot. The hydraulic work which has been undertaken at this point includes the dam across the stream, the water inlet and the canal which is designed to conduct the water from the river along the bank to the station building containing the turbines. The head of water which is obtained in this way reaches ninety-one metres (296 feet), and the flume which brings the water to the generating station is constructed for delivering five cubic metres (180 cubic feet) of water per second. The normal output is somewhat below the latter figure, however.

The main part of the total output of the river, or seventy per cent, belongs to the communes of Chaux-de-Fonds and Locle. The remainder belongs to the city of Neuchatel. The water which is utilized by the former localities is brought from the flume down to the turbines in the station by two penstocks of sheet steel 1.1 metres in diameter and 200 metres (650 feet) long. The main dynamo room of the Combe-Garot plant is laid out to receive nine principal generating groups. Of this number six are now installed and it is expected to add the remainder in the near future. The power given by the stream during times of average flow allows of operating eight generating sets at the same time. The eight groups of the station are connected in series according to the system adopted by M. Thury, with one group as a reserve. They are designed to produce at full load a current of 150 amperes and a total voltage of 14,400 volts. This corresponds to a total of 3,000 horse-power for the eight groups. The regulation of the current, which is to be kept at a constant value, is carried out by varying the speed of the turbines. To this effect the wheels, which are furnished by Piccard & Pictet, of Geneva, have been built especially for the purpose and are made as light as possible. As the inertia of the masses in movement is comparatively small, an automatic regulation is produced within certain limits, seeing that the fields of the machines are but slightly saturated. It is found in practice that when the current in the circuit increases, owing to a diminution in voltage which may occur, the resistant couple of the generators increases about as the square of the current, and the turbines are thus made to slow up automatically, owing to the increased resistance and furnish less work in this case. The manœuvres of regulating the turbines can

also be carried out very easily by hand and consist simply of opening or closing the turbine gates. In addition to this a type of automatic regulator is used in connection with the machines with a view of obtaining a still better regulation than the above. This system of regulation, which is one of the interesting features of the plant, will be observed in the engraving (Fig. 1). It consists of a series-wound electric motor whose armature, however, does not make a complete revolution, but oscillates to and from and is balanced against a spring. The armature makes about one-eighth of a revolution at the maximum. The position of the armature in the field varies with the value of the current. It is connected to a long shaft which passes over all the turbines of the series. This shaft is made up of light tubes which are supported on ball bearings at the proper intervals. This transmission acts by means of a suitable lever mechanism upon the regulating hydraulic motors which operate the inlet vanes of the turbines. As will be observed, the regulating device is mounted on the top of each turbine.

The generators of the Combe-Garot plant are of the Thury pattern and have six consequent poles. The field bore is 1.25 metres (fifty inches). The armatures of these generators are drum-wound and they are excited in series. The present machines have been designed to furnish direct current at 150 amperes with a voltage which is variable according to the load on the circuit. It can use as high as 1,800 volts at the maximum turbine speed and field strength. Under these conditions the speed is 300 revolutions per minute. From this point they can be run down to as slow a speed as twelve revolutions per minute, when they are still capable of exciting their fields and will deliver a current of 150 amperes at a low voltage. At the time of making the trials on the dynamos in order to test the insulation, they were run as high as 2,700 volts, with a very good performance. Each of the dynamos is provided with a short-circuiting switch which is placed opposite it, together with a reversing switch. A small switchboard which carries an ammeter and a standard voltmeter allows the superintendent of the station to check up the working of the machines and plot the daily curves.

The station is supplied with lightning arresters of the Thury pattern which break the arc by an automatic mechanical device. The lightning arresters are placed on each side of the main circuit at the point where the line wires enter the building. Each of the lightning arresters is supplemented by four choke coils and two condensers which are mounted in series. The Combe-Garot plant runs continuously during the twenty-four hours and is looked after by three station superintendents, who take turns of eight hours each.

The line which connects the main station with the two substations where the power is received is a simple series line of two wires. It runs overhead throughout its whole extent. The disposition of the line and the three stations will be observed in the accompanying map (Fig. 2) which contains a scale in kilometres. The two substations are located at Chaux-de-Fonds and Locle. On leaving the Combe-Garot plant, the line mounts up to a considerable altitude in order to come out of the gorge, through which it passes for some distance. At an altitude of 1,350 metres (4,200 feet) it clears the chain of the Jura which separates the Areuse river from the Chaux-de-Fonds plant. Over a length of six miles after leaving the main station the two wires of the line are mounted on the same poles. From here on they branch out in different directions and one wire is brought to Chaux-de-Fonds. From this point, after passing the motors at the substation which are connected in series, the line is brought to the second station at Locle, which lies some six miles from the former place. It passes the motors in series and returns to the former branch point, thus forming a complete circuit in which all the machines are connected in series. The section of cable which is used for the main line is 150 square millimetres and the total length of the line is fifty-two kilometres (320 miles), comprising the loops which are necessary at each of the substations. The line wire is mounted upon double-bell porcelain insulators of an improved design. The difficulty has been found so far in keeping the line well insulated, even at high voltages. The poles are spaced eighty metres apart. When the line passes through the towns it is mounted upon high poles and specially protected so as to avoid accidents to the telegraph and telephone lines. The circuit of the motors is formed of four loops, two of which are at Chaux-de-Fonds and two at Locle. Each of the loops containing the motors can be thrown out of circuit independently by a switch. These switches which are specially designed for the purpose, are mounted on the line poles and are enclosed in an iron box. When running at half the normal load, the drop in the line is 864 volts. This corresponds to a loss of twelve per cent. At full load, where the voltage rises as high as 14,400 volts with the constant current of 150 amperes, the loss in the line is reduced to six per cent of the total energy.

The main part of the current which is transmitted to Chaux-de-Fonds and Locle is utilized by motors in series which represent a total of 2,000 horse-power. These motors operate a corresponding number of direct-coupled generators which furnish the lighting current for the different localities and also for running small motors. The latter generally operate at two voltages, either 150 or 300 volts. At the Chaux-de-Fonds substation two of these direct-connected groups are used specially for the electric tramway lines of the locality and for a number of motors which work at 500 volts. Outside of the main stations there are seven large motors installed at present, which furnish power for different factories in the region. These motors represent a total of 500 horse-power. All the motors over twenty horse-power are operated by the main line circuit in series, while the smaller motors are supplied by the secondary lighting mains at either 150 or 300 volts, or from the tramway circuits at 500 volts.

The principal substation, which is located at Chaux-de-Fonds, has been laid out for eight motor-generator groups of the type which is shown in Fig. 3. Each of the groups has an automatic regulator mounted upon it. The regulator is operated by belt from the shaft and throws resistance into the field-circuit according to the speed of the machine.

The lighting circuit for the locality is laid out on the three-wire system. To carry this out, two groups of 200 kilowatts each are connected upon the outer wires of the system and work at 300 volts. The line is balanced by using two special groups which act as compensators. These groups are made up of a 120-horse-power motor which has a generator mounted on each side of it and direct-coupled. The motors and generators resemble the type shown in the engraving. Each of the generators delivers current at 160 volts which is used for balancing the three-wire circuit. As to the main generators which work at 320 volts, their winding has been designed so that they can be also run at 500 volts. This arrangement has been adopted so as to allow the machines to be utilized as reserve groups for operating the tramway circuits and also to obtain the needed voltage for charging the two batteries of accumulators which are

used in parallel with the lighting circuit. The 500-volt distribution is operated by two direct-coupled groups of 200-kilowatts each, in connection with a storage battery. The voltage of the battery is regulated to the required point by a special booster set. The efficiency of the 300-horse-power generating sets was guaranteed to be eighty-two per cent at full load. Under the different tests which were made at the time of starting the plant the machines showed even a better figure than this, as the motors and generators, when tested separately, gave an efficiency of 93.5 per cent each, which makes about eighty-seven per cent for the combined group.

Owing to the increased demand for power, the Chaux-de-Fonds station soon ran up to the limit for which it was designed, and it became necessary to increase its capacity. This was carried out a few years ago, when it was decided to add three new batteries of accumulators to the station. The two batteries which supply the 300-volt circuit are charged by the main dynamos of the station, as it was found that the voltage could be raised sufficiently high to carry this out. On the other hand, the battery which works on the 550-volt circuit is charged by a booster group, provided with an automatic regulator, which receives current direct from the main line. The second battery is mounted directly in shunt upon the circuit and serves to take up shocks or a temporary overload. It contains 250 cells. As the variations of load on the tramway circuit are quite considerable, and on the other hand a constant voltage is required, the booster which is used to regulate the voltage is connected permanently in series with the battery. It raises the voltage delivered by the battery during its discharge. Upon charging the battery from the line, the booster helps out the latter, and keeps the charging potential at the right point. To carry this out, an automatic voltage regulator which is connected with the field of the booster is mounted on the top of the machine and resembles the regulator of the principal machines (shown in the engraving). The regulator serves to vary the field strength and consequently the voltage delivered by the booster within the required limits, which are as follows: at the end of the charging period the voltage which is needed for the battery is 250 by 2.6 volts (per cell), or 650 volts, of which 550 volts are delivered by the main circuit and 100 by the booster. At the end of the discharge, the battery has dropped in voltage, and now only furnishes 250 by 1.8 volts or 450 volts. During this period the booster is required to fill out the deficiency by supplying the 100 volts needed to secure 550 volts for the circuit. By this arrangement it is possible to charge the battery and also to

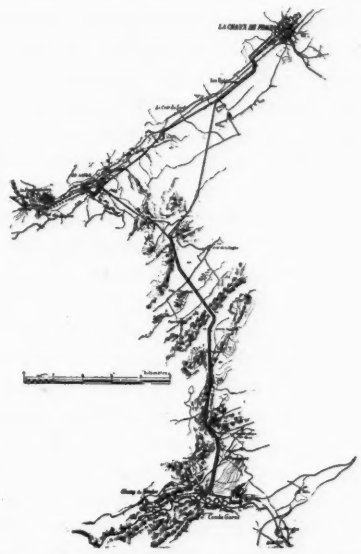


FIG. 2.—THE DISPOSITION OF THE LINE AND THE THREE STATIONS.

discharge it completely with 200 volts variation on the battery, all the while keeping the tension of the distribution circuit at 550 volts. The time which is needed for the automatic regulator to provide for the maximum difference of 200 volts is only fifteen seconds. The booster group which is used with the battery consists of a forty-five-kilowatt motor which is connected in series on the line, and is direct-coupled to a forty-kilowatt generator. This group operates at 550 revolutions per minute. By the above methods of regulation, the voltage on the Chaux-de-Fonds circuits is kept nearly constant, as is shown by the fact that the maximum difference from the normal is not over one per cent.

Besides the main plant which has been installed at Chaux-de-Fonds, it was decided to install a special reserve station which should operate in connection with the former. This became necessary after the secondary circuit had reached a considerable development and the load on the station was increased. During the winter season the hydraulic power supplied to the main station would no doubt be insufficient to furnish the necessary current and therefore the present increase was decided upon. The new plant is located on the premises of the city gas works, although it lies considerably out of the centre of distribution, as it was easy to obtain sufficient space and also a good supply of combustible. The reserve plant is laid out so as to supply either the primary or the secondary circuit as desired. As to the method of distribution to be adopted for the reserve plant, two different considerations had to be taken into account. In the first place, seeing that several of the large industrial motors are placed directly on the primary circuit, it was desired to give them the benefit of the current from the reserve plant. Besides, the primary line passes in the neighborhood of the gas works and there would be no new expense for wiring. On the other hand, however, it did not seem practical to carry out a transformation upon the greater part of the energy which the reserve plant delivered, on account of the losses which would result from this, and also the increased number of em-

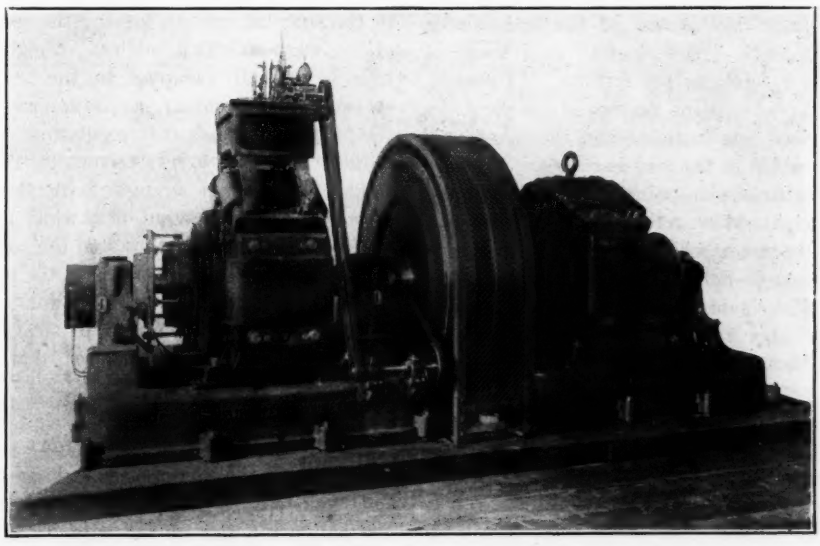


FIG. 3.—THE CHAUX-DE-FONDS GROUP.

ployés which would be needed in case two different plants were installed. Accordingly, the present method was adopted as it assures the good operation of the plant under the above conditions.

Each of the two generator groups used for the reserve is operated by a 250-horse-power gas motor. Any one of the groups can be coupled upon either one of three circuits. First, upon the primary or main line, to which it delivers 1,150 volts and 150 amperes. Second, on the 550-volt line to which it supplies 575 volts and 300 amperes. Third, on the lighting circuit, giving 320 volts and 540 amperes. To carry out this result it was only necessary to install generators which should be powerful enough and at the same time provided with two distinct armature windings which could be connected in series or parallel. This arrangement has now been carried out and the machines are coupled to either of the three different circuits by a specially designed switch. A small separate switchboard is placed in the station for use when the machines are working on the primary circuit, so as to give a distinct separation of the secondary circuits from the primary. The gas engines are started up by using the generators as motors.

As soon as the gas engine is up to speed the machine is thrown off the 500-volt circuit and connected to one or the other circuit which it is desired to supply. The generators for the reserve plant are coupled direct on the shaft of the gas engines by means of Raffard elastic couplings. They operate at a speed of 160 revolutions per minute. At present, the reserve plant has two of the above described sets installed and the others will be added as the load increases. The total number of generating units to be installed is eight, which represents a total of 2,000 horse-power which can be added to the Chaux-de-Fonds station.

The substation which is installed at Locle is smaller than the former. At first it consisted of a temporary plant containing but one group of 175 kilowatts. This group was made up of a series motor which had two generators mounted on the shaft. These dynamos delivered a tension of 165 volts. But as the demand for current increased, the capacity of the plant was soon exceeded. The final disposition of the plant included a reserve station operated by steam, together with a pumping plant for supplying water for the locality. The elevating pumps are operated by series motors. When entirely completed the Locle plant will be formed as follows: first—three groups which will form a reserve during periods of low water. These groups are each composed of a vertical compound steam engine of the Suzer (Swiss) make, operating at 300 revolutions per minute, with a capacity of 250 horse-power. The engine is direct-coupled to a Thury generator which contains a double armature winding. Each of these dynamos can therefore work on the primary circuit, to which it delivers 1,150 volts and 150 amperes, or on the secondary mains supplying 325 volts and 540 amperes. The two windings of the armature are coupled in series in the former case and in parallel in the latter. One of these groups is now working in the reserve station. Second—two rotary groups of 200 kilowatts each, which are formed of a series motor and a generator which is designed for 325 volts and 600 amperes. Third—three rotary groups of 175 kilowatts, consisting of a 200-kilowatt motor direct-coupled to two generators for the secondary circuits. Two groups of this kind have already been installed. As to the further extension of the plant should the load increase, it is designed to install batteries of accumulators, and to this end all the generators have been laid out so as to run with considerable variations of voltage, and they can also be utilized for the traction lines which may be installed in the future. In case the reserve generators are to help out the primary circuit or to supply it alone, the regulation for constant current is obtained in the simplest way by varying the speed of the engines. This method of regulation is specially adapted to the series system of distribution, as it suppresses the different kinds of regulating apparatus and gives a very economical running. The current strength is regulated once for all by the best cut-off at which it is desired to work the engines, and the latter is chosen at the start according to the type of engine and the best point of working. In this way the consumption of steam is strictly proportional to the speed, that is, to the work which is furnished.

Trolley Wire Specifications.

Electrical engineers, when asking for bids on trolley wire are usually content to specify the size of the wire, its conductivity and the length of the sections. The following specifications which were drawn up by a well-known consulting engineer for a large railway system are much more complete.

In General—The wire contemplated in the following specification is to be used as trolley wire, and it is intended that it possess the best electrical and mechanical properties for such purpose, and shall be uniform in quality.

Size—The size to be No. 00 B. & S. gauge, round, average diameter, 364.8 mils; maximum diameter, 365.8 mils; minimum diameter, 363.8 mils.

Tensile Strength—Shall be at least 55,000 pounds per square inch.

Ductility—The elongation in ten inches shall be not less than three per cent, and the contraction of area at fracture not less than fifty per cent. The wire when gripped between the ends of two vices, six inches apart, shall be capable of being twisted through at least fifteen complete revolutions before breaking.

Conductivity—The electrical conductivity, Matthiessen standard shall be not less than ninety-eight per cent.

Lengths—The wire to be in one-mile lengths, wound on reels of uniform dimensions, in a neat workmanlike manner, and shall be so protected as to free wire from mechanical or other injury during shipment. The exact weight and corresponding length to be marked on each reel.

Testing—The mechanical and electrical tests of wire under this specification shall be made in a manner, and by apparatus approved by the chief engineer of this company, the cost of such test to be borne by the contractor.

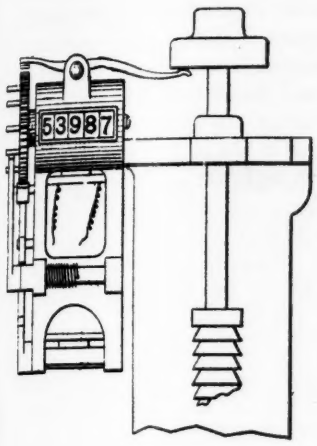
Inspection—The railway company shall have the privilege, if it so desires, of appointing an inspector, who shall oversee the cutting and packing of samples, and be present during the manufacture of the wire.

Lightning Arresters.

In a recent article in *La Revue Électrique* M. J. Blondin describes two types of lightning arrester used with success in Europe. One of these is a magnetic blow-out arrester consisting of three metal parts, arranged so as to form two diverging spark-gaps. These gaps are placed within the field of an electromagnet. One of the outside pieces is connected to the line, the other being connected to the ground. The central piece is connected through the electromagnet to that terminal which is connected to the line. When an arc is formed, due to an atmospheric discharge, the fact that it is divided into two parts makes it easier to extinguish it, and the tendency of the arc to rise is increased by the field set up by the electromagnet. The other arrester is made up of a number of ovoid metal heads supported in line on an insulating bar. The number of these heads placed in series depends upon the voltage of the line. The arc established by atmospheric discharge is divided into several parts, and as these several arcs rise, they increase in length until, at the top of the heads, they merge into one long arc between the two outer heads. The resistance of the arc thus becomes so great that it is extinguished. The shape of the heads enables them to be turned on their supporting pins so as to present fresh surfaces in the gap.

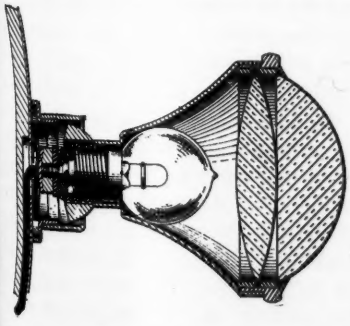
Electrical Patents.

The Strowger Automatic Telephone Exchange, of Illinois, is the assignee of a patent (772,459, October 18) recently granted to John Erickson, of Chicago, Ill., on a counter for registering calls for



Counter for Registering Calls for Automatic Telephone Exchanges.

automatic telephone exchanges. The object of the invention is to provide a device which will register only by means of a plurality of movements, and if the cycle of such movements is not completed the registering mechanism is returned to the position assumed at the end of the last registered cycle. The device comprises a counter, a ratchet wheel connected therewith and provided with stops, the number of stops being an aliquot part of the teeth on the wheel, a pawl and a detent for engaging the teeth, and a detent for engaging with the stops of the ratchet wheel, an electromagnet for actuating the pawl and a movable member connected with the exchange switch for releasing the detent from the teeth, and a spring

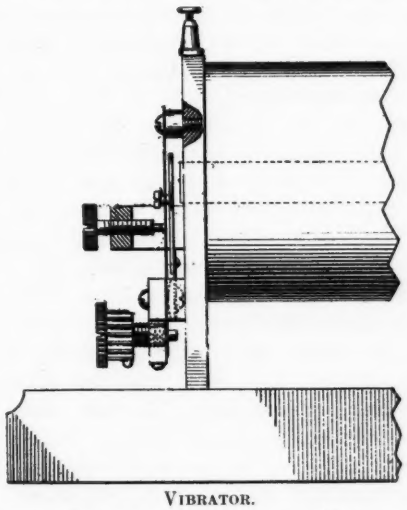


Electric Lamp.

for holding the other detent in engagement with the stops.

George F. Fischer, of New York, N. Y., has assigned to Thomas J. Bull and Henry D. Schaad, of the same place, a patent (772,877, October 18) recently obtained by him on an electric lamp. The device constructed in accordance with Mr. Fischer's invention comprises in combination a support, a lamp socket movably mounted on the support and electrically connected therewith, a contact-piece carried by and insulated from the lamp socket, and a yielding mounted contact member carried by and insulated from the support and arranged to engage the contact-piece. The lamp socket is preferably so connected with the support as to permit of a universal movement between the parts, and, in order that the electrical connections between the contact-piece carried by the socket and support may be rendered permanent, the yielding mounted contact member is preferably connected directly to a flexible conductor forming part of the circuit, the conductor forming the other pole of the circuit being connected to the support upon which the lamp is mounted.

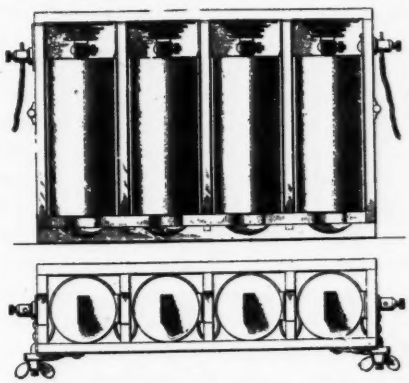
New and useful improvements in vibrators have been invented and patented



Vibrator.

(772,438, October 18) by Charles F. Splitdorf, of New York, N. Y., the object of which improvement is to provide a movable contact carrier in the form of a tensional buffer for the armature, located in the line of magnetic attraction of the latter. It is the purpose also to provide means whereby the hammering of the buffer by the armature imparts a degree of vibratory motion to the movable contact which may be increased or diminished by registering the tension of this buffer. The invention consists of a strip or ribbon of thin spring metal carrying the usual movable contact that forms one of the electrodes in circuit-interrupting mechanism of this class, this spring being rigidly held at its opposite ends under a desired degree of tension, and means for regulating such tension, together with an armature in the field of an electromagnet, the armature having a rigid connection adapted to hammer the spring to separate the movable contact from the usual fixed contact and to set up a vibratory interrupter action in the spring.

Frank Jackson, of Denver, Col., is the inventor of a battery holder (772,415, October 18), the object of which is to provide for instantaneously connecting the batteries in their spark-producing circuit without the necessity of wiring the several batteries to each other. The invention consists of a series of batteries and a box therefor, comprising a series of compartments and a substantially



Battery Holder.

cylindrical resilient metal jacket secured in each compartment, each jacket being open on one side from top to bottom and adapted to tightly enclose one of the batteries. A conductor plate extends from each jacket to the top of the box, where it is bent at right angles to extend into the adjoining compartment and bear against the under side of the top of the box. Secured to the under side of a portion of the conductor is an expansion spring, and a contact-plate is secured to the spring and thereby pressed upon the carbon of the battery in this compartment, so as to firmly hold this battery against the bottom of a box. A door is provided for this box and also means for securing this door so it shall press against the batteries.

The Anniversary at Columbia University.

On Friday afternoon, October 28, the 150th anniversary of the founding of King's College in New York city was celebrated. A reception was given by President Nicholas Murray Butler and the trustees of Columbia University.

At three o'clock in the afternoon all the buildings on Morningside Heights were thrown open to the public for inspection. The visitors were received by student and faculty marshals. Informal teas were held in all departments of the college. In the evening a dance was held in the gymnasium of the university, and this was attended by many of the Columbia alumni and under-graduates. Banquets were held by the Society of Columbia University Architects and the department of electrical engineering.

The programme for the formal exercises included receptions and ceremonies up to Monday, October 31.

Reviews of Current Engineering and Scientific Literature.

Comparison of Small Inductances at High Frequencies.

An accurate comparison of small inductances has always been difficult. On the other hand, there is little trouble in determining the capacities of exceedingly small condensers. In the latter work, by means of high frequencies, the limit of the error is about one per cent, but a similar method is not suitable for inductance measurements, because it is difficult to avoid the reactions of the neighboring parts of circuits. When a bridge method is used a balance which is not true may be obtained. To avoid these difficulties Mr. A. H. Taylor has adopted a method depending upon the resonance of a circuit containing a capacity and the inductance to be measured. These and a galvanometer are connected in series, a source of alternating current is applied, and the circuit is completed by means of two parallel wires bridged with a heavy copper bar. These two wires form a variable inductance, enabling the circuit to be brought into resonance. Then, knowing the capacity and the frequency, the total inductance of the circuit is determined when the galvanometer shows that resonance has been established. The adjustable inductance is proportional to the length of the horizontal wires included in the circuit, and this can be determined and deducted from the total. A determination of the accuracy of this method showed that, when the parallel wires had a diameter of 0.146, and were 10.08 centimetres distant from each other, and the computed inductance was 1.143, the inductance determined by measurement was 1.139, an error of 0.35 per cent. In using this method, the mutual action of parts of the circuits should be prevented as much as possible. This method is not applicable to the comparison of the inductances whose resistances differ widely.—*Abstracted from the Physical Review (Lancaster), October.*

The Dangers of Producer Gas.

When using producer gas great precautions should be taken to prevent accidents due to its poisonous character and a note of warning is here uttered to those who find it necessary to work with this gas. The risk arises from the presence in water gas, power gas, producer gas, blast furnace gas, etc., of a large percentage of carbonic acid. This is one of the constituents in ordinary coal gas, but in that the proportion is low, varying from four to twelve per cent. In water gas it may be thirty per cent, and in uncarbureted water gas as high as fifty per cent. In other gases it ranges from ten to twenty-five per cent. Carbonic acid is an active poison, and one of the greatest dangers arises from the fact that it is inodorous, and its physiological effect is very insidious and cumulative. The victim usually becomes overpowered with drowsiness, and by the time he realizes the danger is unable to escape. The deadly character of carbonic oxide poisoning is shown by records covering five years in England; out of fifty-one cases of such poisoning, seventeen were fatal. These accidents were traced to several causes, among them being leakage from pipe joints, gradual escape of gas within a confined atmosphere in a small engine room, cleaning of tanks or flues before the gas has escaped, flues placed underground, the inodorous nature of the gas, and the workman's ignorance of the danger and of the earliest symptoms produced by it. There is also some danger of carbonic oxide poisoning from the use of gas irons and gas stoves in imperfectly ventilated rooms. The most prominent symptoms of this poisoning are giddiness, palpitation, weakness of the limbs, and headache. The best remedy for poisoning of this kind is fresh air, artificial respiration, administration of oxygen and the application of warmth. The precautionary measures to be adopted where there is any risk of this poisoning should be, thorough ventilation of the rooms where the gas is liable to accumulate, allowing only competent persons to have access to and inspect piping and valves, and the provision of suitable medical appliances, such as the oxygen cylinder and its fittings for instant application if necessary.—*Abstracted from the Mechanical Engineer (London), October 15.*

Chimney Action.

Formulæ for chimneys show evidence, according to Mr. W. H. Booth, that the framer of the formulæ, or the man who tore them from their context and nailed them down in the pages of a handbook, did not realize facts. To speak of the horse-power of a chimney is ambiguous, as it may refer to the power of the steam engine served by the chimney, or to the power required to do the work of the chimney. Taking an average case, with the flue gases at about 360 degrees, it is found that the heat units escaping at the chimney are about one-tenth of the heat value of the coal. For an ordinary boiler with forty square feet of grate, burning twenty pounds of coal per square foot of grate area per hour, the heat escaping up the chimney is equivalent to 448 horse-power, or about thirty horse-power if used in a fair engine. The work actually done by the chimney in lifting the gases is about two horse-power, making the efficiency of this apparatus about five per cent. The common idea that the chimney acts by suction is wrong. The action is due to a greater pressure of the air surrounding the chimney, and not due to a partial vacuum created in the chimney. For this reason dampers located in the flue or narrow and contracted flues are bad. Dampers should be located there only when it is desirable to shut off one boiler from the flue. Frame dampers are objectionable, because of the opportunity for leakage. The best place for the damper is in the ash-pit. Analysis of chimney gases often bear little significance because no allowance is made for the great leakage of air into the flue and through the walls of the chimney. There is no advantage in building a high furnace bridge, as this merely introduces an obstruction to the easy flow of the gases, and does not add to the efficiency of the furnace. The draught chimney is dependent upon several factors—the height, the area, and the temperature of the gases. Increasing the height diminishes the pressure at the chimney base. An increase in temperature has the same effect, and an increase in area reduces the velocity of the gases, thereby reducing friction. The acting power of a chimney varies as the square root of its height. An increased height therefore tells rapidly in chimneys of 50 to 100 feet, but when heights of 200 feet are attained an increase adds but little. Similarly, the action of temperature in promoting draught is a function of the absolute, not of the thermometric temperature, and very little benefit is gained by chimney temperatures over 300 or 350 degrees Fahrenheit. While the draught velocity is increased, the weight of the

gases delivered is hardly increased at all with higher temperature, and actually falls off again above 600 degrees Fahrenheit. As chimneys are expensive luxuries, it is important that they should not be overloaded by being called on to carry more air than necessary. Excessive air is caused by uncovered bars and bad brickwork. The weight of air used per pound of coal may be as low as fifteen pounds. It may be as high as fifty. In ordinary practice there is usually a wide margin for improvement on this score. A chimney is a compromise of height, area and temperature conditions, with the uncertainties of future combustion and future plant conditions to modify its present apparent best design; hence the value of forced draught in electric power stations, which may or may not grow in size, and can at any time be given the necessary draught plant.—*Abstracted from the Electrical Review (London), October* 14.

Measures for Preventing Electric Railways from Affecting Electrical Instruments in Physical Laboratories.

Electric generating stations may affect electrical measuring instruments in two ways—first, by the magnetic field set up, due to magnetic leakage of the machinery, and, second, due to wandering electric currents. Magnetic leakage need not be considered, as this influence can be felt only a short distance. Disturbances due to stray currents have, however, given trouble, and unless these can be avoided serious inconvenience will be caused to the laboratory. If, on the other hand, electric railways are not allowed to approach the laboratory, an important section of the city may be left without much needed transportation facilities. In this study of the subject Herr Björkegren takes up the first work which a laboratory may be called upon to do. If it be an institution at which original research is carried on, such, for instance, as the investigation of the earth's magnetic field, the only remedies are to remove the apparatus used for this purpose to some isolated situation, or to compel electric tramways which pass near it to use accumulators. For nearly all other work the disturbances due to earth currents may be avoided by discarding the movable-needle type of galvanometer for the D'Arsonval or movable-coil type. This has been done in some cities in Germany, the railway supplying the new instruments. For exceedingly delicate work, where the D'Arsonval type of instrument is not suitable, magnetic shields should be adopted. By means of a triple shield of cast steel, magnetic disturbances may be reduced to about one-tenth of one per cent of what they would be without the shield, and this will, in general, suffice. One case cited was at Charlottenburg, where the railways desired to pass near the Physikalische-Technische Reichsanstalt. The railway agreed to separate the section of track passing near the institution from the other parts. This section is supplied from a separate power-house. It agreed not to install a power-house within one kilometre of the institution, and to run its cars at reduced speed when passing near the latter. On this section of the track a double trolley was adopted. Other physical laboratories at Berlin have discarded the movable-needle galvanometer for the D'Arsonval type, and it is thought that the accumulator systems at present in use will be replaced by the overhead trolley, suitable precautions being taken when passing in the neighborhood of these institutions.—*Translated and abstracted from L'Électricien (Paris), October* 15.

The Utilization of the Falls of the Zambesi.

As has already been noted, plans are being carried out for developing the power of Victoria falls, on the Zambesi river. These falls were known previous to the year 1600, as is shown by Portuguese maps now in the British Museum. They were rediscovered and described by Livingstone in 1855, who gave them the name they now bear. The native designation means "smoke which makes a noise." The falls are situated about 350 kilometres (220 miles) northwest of Buluwayo, a city on the railway line connecting Cape Town, Kimberly, Buluwayo, Fort Salisbury and Beira. The line which crosses the Zambesi river at the falls branches from this other line at Buluwayo. In this article M. F. Miron considers the development of the falls, particularly with reference to the distribution of power throughout South Africa. According to measurements made by English engineers, the flow of water of the Zambesi at this point is double that at Niagara, and it is estimated that the power represented is 25,000,000 horsepower—five times that of Niagara. However, during the dry season there is a considerable decrease in the flow of water. The nearest towns are Buluwayo, having 6,000 inhabitants (number of whites unknown), and Palapye, having about 20,000 inhabitants, of whom 200 are white. Salisbury and Gwelo are important points, but the number of inhabitants is not known. The first has 500, and the second 800 whites. Considering cities at a greater distance, the most important are Pretoria, with 15,000 inhabitants, and Johannesburg, with 220,000 inhabitants, 80,000 being whites. Kruegersdorf has 2,000 whites, and Victoria 25,000 inhabitants, 300 being white. There are several towns with from 6,000 to 1,000 inhabitants. Supposing, even, that power can be distributed to these points, they will consume but a comparatively small amount. It is thought that the most promising field for exploitation will be in the operation of gold mines, driving the stamps, pumps and other machinery. The power at present used on the Rand for this purpose is about 45,000 horse-power, and when the mines there have been put into good shape this will be doubled. The district of next importance is Rhodesia, which is north of the Transvaal. To-day this district uses 12,000 horse-power, but this will be increased considerably as the country is settled and developed and by the opening of new mines. There are also coal mines to the north of the Transvaal, where power could be used to advantage. It is not thought that there will be any electrochemical developments, since the station will be 2,560 kilometres (1,587 miles) from Cape Town, and it will be necessary to transport to and from the station all the material treated. If, however, the British South Africa Company continues the programme of Cecil Rhodes, and transforms Rhodesia into an agricultural district, the Victoria power-house will find an important outlet. As is the case in all South Africa, Rhodesia is not irrigated naturally, and it will be necessary to introduce artificial irrigation, the Zambesi furnishing the force and the water. It is thought that there will be a great deal of difficulty in constructing high-tension lines in the neighborhood of the falls, on account of the enormous volumes of spray sent up there. This spray attains a height of 150 metres (500 feet), falling in the shape of a fine rain over the surrounding territory. During periods of high water these columns of spray, and even the noise of the falls, can be heard fifteen kilometres (9.3 miles). It is thought that eventually the falls of the Zambesi will supply power to all of industrial South Africa, thus transforming its immense solitudes into a prosperous empire.—*Translated and abstracted from L'Industrie Électrique (Paris), October* 10.

Report of the United States Naval Liquid Fuel Board.

A report covering the work of the United States naval liquid fuel board has been issued. To determine the suitability of the Hohenstein water-tube boiler as a steam generator for ships of war, one of these boilers was set up at the Washington navy yard and subjected to a searching test. This test being completed, it was suggested that an excellent opportunity was afforded for testing various kinds of fuel, particularly with a view of obtaining data for comparing oil with coal as a fuel for warships. Tests were begun with coal in the latter part of April, 1901, and were completed in January, 1902. Tests of oil followed.

The results of the capacity tests of the experimental boiler showed that naval administrators would be justified in prescribing that all straight-tube naval boilers should be required to burn at least forty pounds of coal per square foot of grate per hour under forced draught, and that in order to effect such a rate of combustion, the limit of air pressure may be allowed to reach two and one-half to three inches of water. By reason of the practical ability to secure increased coal combustion in marine boilers of the water-tube type, the maximum indicated horsepower now required of each foot of grate surface should be increased.

In the tests with oil various types of burner and various arrangements of the furnace were employed. The oil used was, in most of the experiments, from the Beaumont (Tex.) fields. It had been subjected to an inexpensive treatment which removed the sulphur and some of the more volatile hydrocarbons.

Some of the conclusions drawn from these tests are, that there should be no difficulty in burning oil in a uniform manner with an intelligent fire-room force. For general purposes, on shore, steam is a better spraying medium than air, but the consumption of fuel oil can not be forced to as great an extent, with steam as the atomizing agent, as when highly heated compressed air is used for this purpose. This is an important point on board warships. It was found that the evaporative efficiency of crude and refined oil is practically the same, no matter from what locality the oil may come. However, the danger of using crude oil is greater. The oil should be heated in some way to secure a uniform supply, and reserve burners should be installed. The simpler the furnace, the greater its efficiency. Firebrick arches only reduce the volume of space necessary for effecting complete combustion. Oil enables the marine boiler to be forced more readily than coal, but when thus used it does not remove the smoke nuisance. No attempt should be made on war vessels to use oil as an auxiliary or supplementary to coal. Such an installation is certain to prove unsatisfactory. It is thought that the mechanical features of the liquid fuel problem have been practically and satisfactorily solved. For manufacturing purposes the financial and supply features are the only hindrances to the use of crude petroleum as a standard fuel. For mercantile purposes the commercial and transportation features of the problem are existing bars which limit the use of oil fuel in merchant ships. For naval purposes there is the additional and serious difficulty to be overcome of providing a satisfactory and safe structural arrangement for carrying an adequate bunker supply.

In considering the problem of attempting to use oil as a fuel for either marine or naval purposes, it should be remembered that the available supply of crude petroleum that could be used as a fuel would not meet over three per cent of the world's demand for coal and other combustibles. For a time, therefore, efforts should not be made to use fuel oil except for special purposes in particular localities.

BOOK REVIEW.

"Mechanical Appliances, Mechanical Movements and Novelties of Construction." Vol. ii. Gardner D. Hiscox. New York. The Norman W. Henley Publishing Company. Cloth. 400 pages. 6 by 9¼ inches. 970 illustrations. Supplied by the ELECTRICAL REVIEW at $3.

This volume is supplementary to vol. i, by the same author. The book takes up a great many mechanical appliances, describing them briefly, in some cases almost too briefly. It is, in fact, an encyclopædia of mechanical movements, and, as such, gives but little information about each device, sometimes only saying what it is for, without describing its operation. These appliances are conveniently classified. Thus, we find a section devoted to transmission of power, measurement of power by means of springs, generation of power, air power motors and appliances, including kites, balloons, gas devices, electric power devices, etc. The most interesting chapter to the reviewer is section 23, which is devoted to perpetual motion. In this the author says that the history of the search for perpetual motion does not afford a single instance of ascertained success. All that wears any appearance of probability remains secret, and, like other secrets, can not be defended in any satisfactory way against the opinions of the sceptical, who have in their favor, in this instance, an appeal to learned authorities against the principle of all such machines and the total want or operativeness in all known practical results. Public statements afford sorry examples of talents and ingenuity strangely misapplied. The author has here brought together fifty-seven devices, some of which have been patented, and each of which the inventor hoped—or said he hoped—would solve the problem. In a great majority of these the error is, of course, obvious. In others it is not so easily seen, and these are not only interesting reading, but present a number of nice problems for solution. If the many perpetual motion seekers would run through this section of the book they would be saved time and chagrin, since they would here see what has already been tried and found wanting. The book has a good index.

Dr. Silvanus P. Thompson on the Third Rail.

Contact with live third rails on English electric railways has been the cause of a number of accidents recently, several being fatal. This has started a discussion of the danger of the third rail and the necessity for adopting this means of conveying current to electric trains. Among others who have taken part in this controversy is Dr. Silvanus P. Thompson, who, in a letter published in a recent issue of the *Times*, London, says:

"In view of the numerous fatal accidents which have occurred at the 'live rails' lately laid down for electric propulsion on some of our railways, the public is naturally beginning to ask for something more than a makeshift protection. Unfortunately, neither the public nor the not-electrically trained railway engineers appear to realize that the 'live rail' is itself already an obsolete device, discarded in the latest types of electric railway. In ten years' time there will probably be no 'live rail' left. I am no lover of overhead wires or conductors, in places, such as our city streets, where they endanger the public. But, if there is one situation where overhead conductors can be placed and maintained safely, that situation is over a railway, particularly an underground railway. Already the 'live rail' has been discarded in at least two places in the United Kingdom. It is an engineering blunder. I would therefore ask whether the time is not ripe for public opinion in some effective form, such as a departmental enquiry, to step in and prevent the railway engineers of England from committing our railway systems any further to this dangerous and unnecessary device."

American Institute of Electrical Engineers.

Papers on the Telautograph and Transposition of Electrical Conductors Read at the 190th Meeting.

THE one hundred and ninetieth meeting of the American Institute of Electrical Engineers was held at the Chemists' Club, 108 West Fifty-fifth street, New York city, Friday evening, October 28. The new president, Mr. John W. Lieb, Jr., was in the chair and opened the meeting by calling upon the secretary, Mr. Ralph W. Pope, who announced that, at a meeting of the directors, held during the afternoon, forty-four associates had been elected. Mr. Pope stated that it had been impossible to secure the meeting room of the Chemists' Club for the regular monthly meetings, but that the chapter room of Carnegie Hall had been leased and would be used for all subsequent meetings.

Mr. Pope mentioned two recent deaths in the Institute, that of Mr. Max Osterberg, which occurred on October 26, and that of Professor B. S. Lanphear.

President Lieb spoke of the work of the Institute and of its officers. The membership is increasing rapidly. It is not only covering a broader field, but the work in the different lines is growing. He thought that the members not personally engaged in this work sometimes failed to appreciate the sacrifices which the officers of the Institute were making.

President Lieb also called attention to the pleasure the Institute had enjoyed during the recent visit of the foreign engineers, and he thought that the reputation of the Institute for hospitality had not in any way suffered from this visit. The valuable set of handbooks of the cities visited during the circular tour formed a very complete reference library. It was greatly to be regretted that it had not been possible to present each member with a set of these books. It was hoped that it would be possible to have them printed and sold, but so far this had been done for only a few of the points visited.

Mr. Lieb then called upon Vice-President Charles F. Scott, who is now chairman of the building committee, to give a statement of the progress made in the plans for the engineering building.

Mr. Scott said that twenty-six architects had submitted plans for the building to the joint committee of the three national societies. These had been sorted out individually by the members of the committee and then, by comparing notes, they had reduced the plans to seven. The committee's architectural adviser was then called in. He had examined the plans, had reduced them to six, five of which had also been selected by the committee. After careful comparison of the different plans, one was decided upon as most nearly meeting the ideas of the committee. Upon opening the envelope it was found that the successful architect was Mr. Herbert D. Hale, of New York city. Mr. Hale was then called in and received the ideas of the committee, and set to work to modify his plans so as to meet its wishes. The work is now going on successfully. The plan contemplates a large lobby on the ground floor, with offices opening out from this. On the upper floors there will be meeting rooms, the top floor being devoted to the library. The building will have an open space entirely around it. On the east Mr. Carnegie has bought the adjoining lot and placed a building restriction limiting any edifice erected there to four stories. On the west a ten-foot passageway will be left on the ground attached to the building, while on the north, light and air will be secured in the same way. Plans are now going forward toward bringing together the libraries of the three national organizations, and it is thought that in this way the finest engineering library in the world will be created.

A plan for administering the building is being perfected. A separate organization, known as the United Engineering Society, will be formed, consisting of one member from each society. By-laws are now being drawn up for the government of this body.

At this point Mr. Lieb excused himself, as he had been invited to attend the dinner at Columbia University in celebration of the 150th anniversary of the founding of King's College. He called Vice-President Calvin W. Rice to the chair.

Mr. Rice, in taking the chair, seconded the remarks of President Lieb in regard to the work of the officers, and to emphasize these, added that President Steinmetz, during his term of office, had come monthly 160 miles to attend the meetings; that President Scott, during his term, had come regularly 440 miles that he might not miss them, and that President Arnold, during the past year, had come 1,000 miles without missing a single meeting.

Mr. Rice called upon Mr. James Dixon to read his paper, entitled "The Telautograph." The paper was briefly abstracted and demonstrations were made with several instruments which had been set up in the room. The instrument, in its present shape, differs considerably from the original Gray type. In the former the variable resistances were in series with the line wires. In the latter the variations in voltage are secured by shunting constant resistances connected across the source of supply. The present state of this instrument is due chiefly to the work done under the personal direction of Mr. George S. Tiffany.

As is well known, the sending instrument consists of two resistances arranged in the form of a circular arc, and proportioned so that the voltage is changed in equal steps as the pen moves the connecting arms uniformly. These variations in voltage are sent out over two line wires, and are passed through the receiver. The latter consists of two D'Arsonval coils suspended in two air-gaps of a common electromagnet. By means of levers the varying currents passing through these coils move the pen so as to reproduce an autographic copy of the motions of the sending pencil. The ground is used as the common return. The pressure of the pencil on the platen allows the pen to come in contact with the paper, and when the pencil is lifted from the platen the pen in the receiver also moves away from its paper. A switch arranged upon the side of the instrument allows the paper of both instruments to be shifted.

The details of both devices have been worked out very completely. The receiving instrument responds instantly, reproducing any record or mark, however quickly made. The set of instruments shown, consisting of a sender and two receiving devices, has been in use for some time past on the battleship Alabama, transmitting messages from the conning tower to the turret. Some fear had been entertained as to the effect of the concussion of the large guns on these instruments. To test this they had been set up within a few inches of the trunnions of the thirteen-inch guns, but in this position were entirely unaffected by the concussion. These instruments were not of the marine type, but had been designed for coast defence service, for which work they are used in transmitting messages from the commanding officer and from the range-finding station to the battery.

Replying to several questions, Mr.

Dixon said that the greatest distance over which the instrument has been used at the present time was seven miles. This was at Portland, Me. It was, however, only a question of resistance. The resistance in this case was about 1,600 ohms. Line leakage, if excessive, affects the receiver, but where this is constant it can be compensated for. No difficulty on this account has yet been met. At the present time they have not used more than seven receivers on one circuit. The only thing which will limit this will be the question of transmitting the energy required to operate the desired number. The maximum current per line is now less than a third of an ampere. The average is about 0.2 of an ampere. The total current taken at any instrument is about one ampere.

Mr. Townsend Walcott spoke of the success attending the tests of these instruments, both in coast defence work and on board ships.

Mr. Frank F. Fowle read an abstract of his paper, entitled "The Transposition of Electrical Conductors." He divided alternating-current transmission systems into two classes, one for the transmission of power, and the other for the transmission of intelligence. Power systems are characterized by high power, large currents, low or moderate frequencies, only one fundamental frequency, relatively great reaction of terminal apparatus with line reactions, magnitude of inductive disturbances in the line usually small and important only as affecting regulation, line-length less than a wave-length, and the flow of energy usually in a given direction.

Telephone systems are characterized by low pressure, small currents, high frequencies available over a wide range, relatively small reaction of terminal apparatus compared with line reactions, magnitude of inductive disturbances in the line, usually large and rarely negligible, line-lengths usually greater than the wave-lengths, and often equal to many wave-lengths, and the flow of energy alternating in direction and source.

He then considered the electric and magnetic fields set up surrounding conductors, treating these analytically. He showed that, where there are not more than three circuits, each consisting of a pair of wires, it is possible to place them so that there will be no mutual interference; but when the number exceeds three, in a practical sense it becomes impossible to prevent this.

He then discussed the transposition of conductors as a means of eliminating these disturbances.

Consider the circuits in Fig. 1.

The additional conditions which are necessary for the disturbances to vanish are as follows. The current in the disturbing circuit must be constant in magnitude and in phase throughout the distance l, and the pressure must likewise be constant in magnitude and in phase. That is, 1 must be so short a portion of the wave-length in the disturbing circuit that these conditions are sensibly fulfilled. At low frequencies the wave-length is not the primary consideration, but rather the drop in line pressure and the decrease of the line current, due respectively to wire impedance and to the leakage and the static charge.

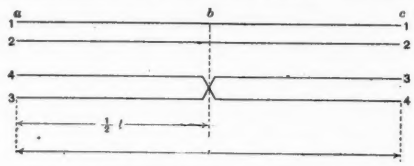


FIG. 1.—TRANSPOSITION OF CONDUCTORS.

As shown by Mr. J. J. Carty, in a paper before the Institute on "Inductive Disturbances in Telephone Circuits," in April, 1891, the induced currents due to electric induction can not be made to vanish entirely, as can those due to magnetic induction.

The treatment of induction between telephone circuits has been by empirical rule rather than theory. It has been determined by experiment, with receivers of a given sensitiveness and transmitters of a given power, how frequently two adjacent circuits should be transposed in order to eliminate the cross-talk. Using two-mile sections, transposed at the centre, the cross-talk is distinguishable with transmission sufficiently powerful for 1,000-mile service. Half or quarter-mile sections, transposed at the centre, are satisfactory; this results in a minimum transposition spacing of one-quarter mile. The existence of cable at each end of the line, in any considerable length, will reduce the cross-talk. It is necessary to devise different types of transposed circuits, no two transposed alike, in order to treat the cases occurring in practice. The manner of doing this is shown in Fig. 2.

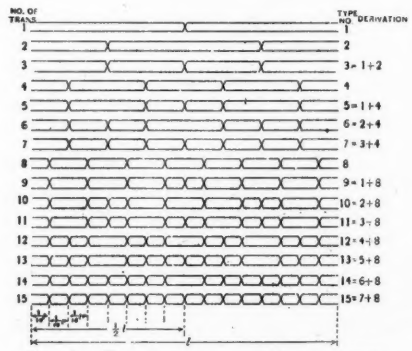


FIG. 2.—TRANSPOSITION OF CONDUCTORS.

The "exposure," as it is termed, of circuit 1 to circuit 2 is one-fourth; of 1 to 3 is one-fourth; of 2 to 3 is one-half; because a transposition at the junction of two sections, each transposed at its centre, has almost no beneficial effect. The exposure of 1 to 5 is one-eighth; of 2 to 6 and 3 to 7, one-eighth; of 2 to 8 and 2 to 9, one-sixteenth, and so on. The tabulated exposures are given in Fig. 3 in terms of the length l of a transposition section. The derivation of the types is simple; the first three are obvious. The fourth is obtained by doubling the number of divisions of the transposition section from two to four. The fifth is obtained by superposing the first type on the fourth type, the sixth by superposing the second on the fourth, etc. The composition of the complicated types is shown in Fig. 2. So far as the writer is aware this synthetical system of deriving types of dissimilarly transposed circuits is due to Mr. John A. Barrett. The method may be extended as far as desired, but fifteen types are usually sufficient.

The choice of a convenient length for l is an important matter. An eight-mile section has been extensively used, but is probably too cumbersome. A much more convenient section would be one four miles in length.

If there are only a few circuits, a two-mile section may be used.

The procedure in applying the sections to a long line is as follows: beginning at the first pole, of the open-wire line, apply the sections consecutively until the last section is approached. It is seldom the line length is a multiple of the section length, so the remainder should be a special section by itself, if over half the length of a standard section, or should be added to the last section, making a special section longer than the standard. The distances between transposition poles will be shortened or lengthened sufficiently to apply the standard section.

When there are several cross-arms it will simplify the construction if the transposition types are so chosen, in laying out a standard section, that there will be as few different types of transposition poles as possible. The junction of two lines which separate, or become joint, is a point which should be made the junction of the transposition sections, as well. The

fifteen types shown in Fig. 2 will be sufficient for a forty-wire line, because there will be certain diagonal exposures requiring transposition only at long intervals, and these extra transpositions may be located at the junction poles between sections.

Phantom circuits, built up from metallic circuits, are not in extensive use. The ordinary transposition is of no effect, and unless specially transposed such circuits will cross-talk and will be subject to extraneous induction.

When telephone lines are paralleled by power lines the transposition problem becomes more complicated. It is necessary to recognize the manner in which the disturbing circuits alter the magnitude of their influence, by reason of abrupt changes in line pressure or line current, and changes in the wire spacings. If circuit 1 to 2, in Fig. 1, is the power circuit and 3 to 4 is the telephone circuit, there will be no mutual interferences if the distance l is not great. That is, the percentage pressure drop in 1 to 2 must be small enough so that the total induced charges on the portion $a\ b$ are sensibly equal and opposite to those on $b\ c$; likewise, the percentage current loss in 1 to 2 must be so small that the magnetically induced pressure in the portion $a\ b$ is equal and opposite to that in $b\ c$. The question as to whether electric or magnetic induction is the greatest is complicated by the radical differences between the systems. In long telephone lines the electric induction may predominate; the impedance of an indefinitely long line is usually several hundred or a thousand ohms, and therefore the pressure is very much greater in magnitude than the current. In power circuits this ratio is dependent largely on the load, in any given case, but there are many instances where the ratio of pressure to current is small. The magnetic induction is usually predominant to a large degree, in the latter cases. There have been instances of exposure to circuits giving twenty-four-hour service, from which the induction was heavy only during the period of load.

If the circuit 1 to 2, in Fig. 1, has connected to it a transformer or a branch circuit within $a\ c$, the effect of the transposition is no longer to neutralize the induction. If the transformer is at b the transposition will have the least effect. If 1 to 2 is a constant-current circuit and an arc lamp is cut in, the effect will be the same, as regards the efficiency of the transposition. A change in the spacing of the wires 1 to 2 will also decrease the effect of the transposition.

Therefore that portion of the disturbing line within which the conditions, affecting the phase or the magnitude of the induced currents and pressures, are constant should be treated as a section and all the telephone circuits should be transposed opposite its centre. The regular cross-talk transpositions should be removed

	Exposure of Type No.												
To	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	½													
3	½	½												
4	½	½	½											
5	½	½	½	½										
6	½	½	½	½	½									
7	½	½	½	½	½	½								
8	⅛	⅛	⅛	⅛	⅛	⅛	⅛							
9	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½						
10	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½	½					
11	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½	½	½				
12	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½	½	½	½			
13	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½	½	½	½	½		
14	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½	½	½	½	½	½	
15	⅛	⅛	⅛	⅛	⅛	⅛	⅛	½	½	½	½	½	½	½

Fig. 3.—Transposition of Conductors.

from the section. If the total external exposure to the power line involves several consecutive sections, the cross-talk transpositions should be opposite the junction of two sections, at the point where the disturbing current and pressure change in magnitude or phase.

An illustration of this is shown in Fig. 4. This is hypothetical, but illustrates various conditions. This method works well until the character of the exposure becomes complicated, and then the transpositions become so frequent as to be impracticable and, further, they frequently can not be properly situated because of physical limitations. If the electric light and power system is developing rapidly the exposures are changed frequently by new construction. Again, the telephone

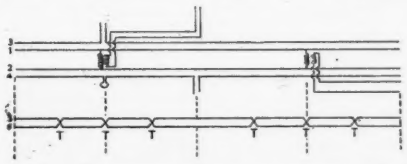


Fig. 4.—Transposition of Conductors—1 to 2, Constant-Potential Circuit; 3 to 4, Constant-Current Circuit; 5 to 6, Telephone Circuit—T, Induction Transposition—T', Cross-Talk Transposition.

line may be separated from the power line by the width of the street; here the induction, while not excessive, is yet troublesome; and the theoretical transposition system to meet the conditions of exposure is just as elaborate as though one line were beneath the other. Twisted pairs of cable will meet this condition, although either remedy impairs the telephonic line efficiency. A prior consideration is whether the power wires are not separated, with respect to each other, farther than is necessary with the pressure employed and whether the separations are uniform.

Where telephone lines have paralleled transmission lines along highways, separated by fifteen or twenty feet, or by the width of the highway, the following practice has been employed. All the telephone circuits are transposed at every tenth pole, the cross-talk transpositions occurring midway, so that transposition poles are five spans apart, the cross-talk and the induction transposition poles alternating. This practice, while it is somewhat uncertain of producing the best results, is probably best suited to certain requirements—where the method of sections would not produce any better results because of the physical unevenness and crookedness of the right of way.

Not infrequently high-pressure systems are transposed for their internal protection. When telephone circuits are on such pole lines, the transpositions in the power circuit may be availed of to reduce induction in the telephone circuits, but in the case of separate telephone circuits, on a parallel pole line of separate ownership, it seems wiser to treat such transpositions as neutral points—to be opposite the junction of two transposition sections of the telephone line. In general, the induction from a three-phase line is slightly greater than from a single-phase line having the same wire spacing and current per wire and a pressure equal to the Δ pressure. The separation between the wires should be as small as consistent with the length of span and their plane suitably arranged with respect to the plane or planes of the power circuits.

It seems to be fairly general practice to transpose high-pressure systems, but it has been the writer's observation that the length of a section is usually three miles at least. On that account it is difficult to avail of the power line transpositions in transposing the telephone line, and it is usually necessary to treat them at the junction points between adjacent sections.

On account of the very low frequency and the high ratio of pressure to current customary in high-pressure practice, there are usually no inductive interferences if the power and the telephone lines are separated by the width of a highway or thirty to forty feet, because the regular cross-talk transpositions are sufficient.

In the case of a single telephone circuit paralleling a power circuit, the frequency

of transpositions is a problem requiring calculation in any given case, because of the lack of standard practice in regard to the wire spacing and circuit location. The writer made a series of listening tests with a bipolar receiver of seventy ohms resistance to determine the permissible current at low frequencies which would not interfere with telephonic transmission over the longest lines—1,000 miles and upward. The method was that of deriving a very small known pressure from a non-inductive resistance and inserting a very large non-inductive resistance R (1,000 to 20,000 ohms) in series with the shunt circuit containing the receiver. The listening tests were made by four observers, who adjusted R to the minimum permissible value, in their estimation. The average results are plotted in Fig. 5.

Naturally these results, based on ear measurements, are not highly precise, but they represent very small disturbances and are safe practice. In the case of short telephone circuits on power lines, used for private purposes, the receiver power may be much reduced and the permissible terminal current greatly increased.

The question of leakage is a consideration prior to that of transposition, for the theory of transposition rests on the hypothesis of electrically balanced circuits. The ordinary pony glass insulator seems to be sufficient where there are no high pressures on the same pole line. In cases of joint lines and of telephone circuits on high pressure lines additional insulation, in the way of heavier insulators, often seems to be necessary. An elaborate discussion of what constitutes good insulation is not in place here, but the best construction in this respect is the first essential to successful transposition.

There are two types of construction in use, in making transpositions. One of these, the old-fashioned square transposition made by dead-ending both wires, each way, on two-piece insulators, and cross-connecting, is familiar to all. The other method is shown in Fig. 6; it requires two spans in which to complete the entire transposition. It is known as the "Murphy" and the "single-pin" transposition, and is coming into general use.

It has the comparative advantages of less first cost and simpler construction. It can be cut in at any time, cut out, or moved several poles, at less cost and with much less work than in the case of a square transposition. If transpositions occur frequently, every half or one-fourth mile, the line capacity is increased a few per cent and the line inductance diminished, with a consequent slight increase in attenuation. The square transposition has the advantage of concentrating the entire transposition within a very short length and of not altering the plane or the separation of the wires. While the single-pin transposition changes the plane of the circuit, the wire separation is greatly reduced and this is an advantage. Since it requires two spans in which to make this transposition, it is possible to transpose only at every other pole, as a maximum, in case of excessive induction, against every pole for the square transpo-

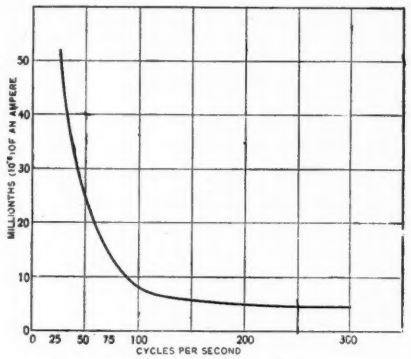


FIG. 5.—TRANSPOSITION OF CONDUCTORS.

sition. For regular cross-talk transpositions the single-pin type is now preferred.

Professor W. S. Franklin, of Lehigh University, regretted that Mr. Fowle had followed the established method of treating mutual inductance and capacity, as this is based upon a fundamental misconception. There is no such thing as a single straight wire or a single charged body. There is always a return somewhere, and bodies charged oppositely which can be found if looked for. Professor Franklin believes that before applying an analytical analysis to any problem, a physical conception must be formed of the actual conditions. When this is done, and only

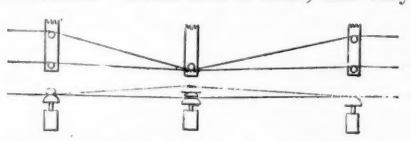


FIG. 6.—TRANSPOSITION OF CONDUCTORS.

then, will the student grasp the fundamental facts. He has found that a mathematical discussion, followed by a physical conception, is almost always valueless. The correct way to teach physics is to teach facts, with mathematics on the side. Maxwell's treatises could be arranged so as to consider pairs of bodies—not a single body.

Replying to a question, Mr. Fowle stated that, with a telephone line, the wires being eight inches apart, and parallel by a 2,000-volt, alternating-current supply, having conductors also eight inches apart, the latter should not affect the former if the two circuits are two or three feet apart and transposition is made every quarter of a mile. The character of the load and the primary voltage affect this somewhat, and must be considered. It is important to prevent leakage, but it is not difficult to do this with suitable insulators. One line which he had tested showed a resistance of 40,000 megohms per mile in good weather.

Replying to a question of Professor A. C. Crehore, Mr. Fowle said that there was no difficulty in running as many telephone lines on a pole as the pole would carry. In doing this it is usual to make the transposition scheme adopted for the fifth cross-arm similar to that of the first, the sixth similar to the second, and so on.

The meeting then adjourned.

Telephone Equipment for the City of Panama.

Mr. E. T. Lefevre, post office box No. 290, Panama, republic of Panama, has obtained from the municipal council of Panama a franchise by which he can establish, maintain in operation and exploit during twenty-five years a system of telephonic communication in the city of Panama and suburbs.

This franchise concedes the right to use the streets and public places for installing central stations, aerial or underground cable, lines, poles, etc., and all that is necessary to operate a first-class, modern plant. The enterprise which he will establish will be exempt during the twenty-five years of the franchise from all municipal taxes. Up to the present time Mr. Lefevre has not made any arrangement for the organization of a company or for the buying of material. It is his purpose, however, to put in operation a central energy system, or recommend to the company which may be organized the installation of such a system. It is his expectation that, within a short time, it will be possible to install in the city alone some 1,000 instruments. Mr. Lefevre also expects to have franchises for other important towns of the republic of Panama within a short time.

Addresses of Foreign Visitors.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The American Institute of Electrical Engineers wants to know the addresses of the following-named foreigners, who visited the States during the summer in connection with the International Electrical Congress: Wilhelm Durnkranz, Baron Wolfgang Ferstel, C. F. Milliken, H. L. Riseley, W. Ziehl.

Considerable mail addressed to the above-named persons has accumulated at the secretary's office, 95 Liberty street, New York city, and should be forwarded to the addresses without further delay. The secretary will be grateful for any information regarding the whereabouts of these men. RALPH W. POPE.

New York, October 31.

AN ELECTROCHEMICAL PROCESS FOR THE TREATMENT OF SILVER SULPHIDES AND GOLD ORES.

BY M. VAYGOUNY.

The use of ferric salts in electrometallurgy has long been known and seems to have been variously exploited since the early eighties, mainly in connection with lixiviation of copper, bismuth and zinc sulphurets, though none of these efforts has, to my knowledge, been crowned with permanent success. However, when, through peculiar circumstances, my attention was called to the solution of some of the difficulties of handling ores of the Mexican type, namely, those which carry their values chiefly as silver sulphides with certain amounts of gold, I was quite ignorant of the history of the particular uses of these salts in metallurgy, as they have never as yet left the confines of patent specifications.

The question, as it came up, was to put the silver sulphide and gold values of certain ores in some soluble form, by some wet method, so that they could be leached out of the mass and subsequently won from the solution. To do this, it was obvious that chlorides of sulphates would be the salts most likely to be practicable for large scale operations. The chlorides or sulphates, moreover, which would best fulfil the condition would not only have to have decided oxidizing properties—since the work to be done was essentially one of oxidation of the sulphides and of gold—but they would also have to be such that they could be regenerated readily, and best, concurrently with the electrodeposition of the values. Of the salts that could meet these conditions best, those of the elements with variable valencies, such as manganese, iron, copper, etc., were, of course, thought the most hopeful, as they are also among the cheapest.

In some preliminary experiments with artificially prepared silver sulphide, it was soon found out that of all these various possibilities, a ferric chloride solution was the best and handiest reagent, and the one that had the least drawbacks. Thus, it acted as vigorously as any of the others, it could be easily electrolyzed in presence of a little acid without separation of any oxides or metal at either electrode, and finally, it is cheap and readily got, or even made at will. As compared with the sulphate, too, the chloride of iron had the advantage in as much as it could furnish the more active chlorine radicals rather than sulphate radicals; and this was desirable, not only because these chlorine radicals, by becoming free chlorine under the influence of the electric current, would act more energetically upon the sulphides, and especially upon the free gold, which, notwithstanding the statement of some authorities, is quite insoluble in ferric salts in the absence of other oxidizing agents, but, as was found later on, it tends to hold in solution goodly amounts of silver or chloride, arising from the interaction between the ferric salt and silver sulphide.

It was, further, soon observed that the presence of much common salt increased the effect of the ferric chloride upon silver sulphide by reason of the reaction:

$$Ag_2S + 2FeCl_3 = 2AgCl + 2FeCl_2 + S$$

somewhat like it did on mercurous chloride or calomel, namely, that it helped to form ferric chloride over again from ferrous chloride, thus regenerating the solution, just as it gives mercuric chloride when added to mercurous chloride. This was soon found, however, not to be the real explanation of the fact. The truth of the case was that the good influence of the concentrated salt solution lay in its power to dissolve out and hold in solution the silver chloride as fast as it formed, thus exposing always fresh surfaces of the sulphide to the action of the ferric chloride.

It was only at this juncture, strangely though happily enough, that I happened to read, for the first time, an account of the efforts of other workers in this branch of metallurgy, and I was thus led to look more seriously into the matter than I had been doing till then. The fact, however, that none of these efforts had been brought to any successful issue gave much ground for deliberation if not for some fear as to the usefulness of any additional sacrifice of time on my part in such a line of work. But it was difficult to overlook the nice way in which the reaction between silver sulphide and ferric chloride went on visibly, especially when warmed in the presence of a little free acid.

Having then come definitely to the conclusion that a stock solution made up of one or two per cent ferric chloride, fifteen to twenty per cent common salt, and a little free hydrochloride acid and charged with free chlorine, would answer well for the purpose on hand, it was next decided to make some actual tests on a few ores, and consequently a series of experiments was carried out of which I may here give the following:

EXPERIMENTAL.

In these experiments the ore used was one obtained from Tonopah. It was a grayish quartzose ore, containing some galena, pyrite, calcite, silver sulphide and gold, with a gangue consisting mainly of quartz. It also contained a notable proportion of metallic iron introduced in the ore through improper grinding.

Experiment 1—In this experiment the ore was ground to eighty mesh to start with, owing to its reputation of being very refractory and, instead of treating it directly with a stick solution of the above named composition, it was thought best to study the influence of a certain amount of ferric sulphate in the solution, for if the solution thus modified should prove as efficient as the one with all of its iron in the form of chloride, it would be of quite an economic advantage, the sulphate being somewhat cheaper. To do this, enough sulphuric acid was, therefore, added to dissolve the free iron in the ore, thus giving ferrous sulphate, which on being chlorinated by electrolysis, or by some means of chlorine gas, gave parts of ferric chloride and ferric sulphate in the proportion of 160 to 400 according to the reaction.

$$3FeSO_4 + 3Cl + Ag = FeCl_3 + Fe_2(SO_4)_3 + Ag$$

The total volume of the solution containing also the common salt and a little free sulphuric acid was about one litre, with an ore mass of one kilogramme (2.2 pounds), or volume per weight. The mass was then warmed and kept boiling for three hours, care being taken that it was always kept well chlorinated. At the end of this time it was filtered and well washed with a saturated solution of common salt, until a few drops of fresh leachings showed no turbidity on being diluted with water, which meant that all the silver chloride held in the solution, wetting the ore mass, had been washed out. It was necessary to use a concentrated salt solution for washing the ore, because had ordinary water or even a very dilute salt solution been used, the solution wetting the ore mass would be diluted thereby, and thus the silver chloride, which is only soluble in the more concentrated chloride solutions, would be precipitated and remain in the ore mass.

When this was done the mass was further washed with some pure water to remove excess of salt solution impregnating the ore, and lastly, it was dried and sent to a professional assayer as tailings.

The following are the results of the

assays of the sample before and after treatment:

RESULTS OF ASSAY, EXPERIMENT 1.
ORE NO. 1.

Sample.	Au. Ounces per Ton.	Ag. Ounces per Ton.
Original	0.8	84.7
Tailings	0.35	4.8

This corresponds to about fifty-six per cent extraction of gold, and 94.4 per cent extraction of silver.

It will be observed from these data that there was much room for improvement as regards the extraction of the gold values.

Having, however, obtained similar results in a second test, under similar conditions, it was then thought interesting to study the effect of the finer crushing of the ore upon the extraction of the values.

Experiment 2—Another lot of the same ore was, therefore, crushed to 120 mesh and assayed for the second time. The treatment was carried out in this experiment identical to the above, in details as to the composition of solution, length of time of boiling or treatment, and, of course, as to care in the method of washing the tailings. Only it was carried out on a lot of one-half pound with the corresponding amount of solution, instead of 2.2 pounds of ore, as was done in the first experiment.

RESULTS OF ASSAY, EXPERIMENT 2.
ORE NO. 1.

Sample.	Au. Ounces per Ton.	Ag. Ounces per Ton.
Original	1.03	86.2
Tailings	0.125	1.1

This corresponds to about eighty-eight per cent extraction of gold, and 98.7 per cent extraction of silver.

It will now be noticed, on comparing the results of these two experiments, that a good deal of the gold values of this ore are very closely locked up in the ore gangue, thus necessitating very fine crushing, and that so far as the silver values are concerned, eighty mesh crushing is practically as good as 120 mesh.

Experiment 3—Since, in the above experiments, the solution had to be kept boiling during the treatment, and since the keeping warm of a mass of ore is quite an item in large scale of practice, the necessity of some experiments to study the effect of treatment in the cold became now quite evident. The following test was, therefore, carried out to elucidate this point.

The ore treated was one-half pound of the 120 mesh sample. The details of treatment were identical with those in the above tests, except that it was carried out cold, and the time of treatment was prolonged to two days with occasional shaking.

RESULTS OF ASSAY, EXPERIMENT 3.
ORE NO. 1.

Sample.	Au. Ounces per Ton.	Ag. Ounces per Ton
Original	1.03	86.2
Tailings	0.575	18.7

This corresponds to forty-four per cent extraction of gold, and seventy-nine per cent extraction of silver.

These data clearly showed the necessity of further prolongation of time of cold treatment, and consequently the following test was then made:

Experiment 4—The conditions in this experiment were identical to those of the preceding experiment, except that hydrochloric acid, instead of sulphuric, was used to dissolve the free iron in the ore mass, whereby all the iron was put into the chloride form on chlorating it instead of part of it staying in the sulphate condition. The time of treatment was extended to three days instead of two, as in the preceding test.

RESULT OF ASSAY, EXPERIMENT 4.
ORE NO. 1.

Sample.	Au. Ounces per Ton.	Ag. Ounces per Ton.
Original	1.03	86.2
Tailings	0.325	6.6

This corresponds to sixty-nine per cent extraction of gold, and 92.4 per cent extraction of silver.

From these last results it can be seen that a three days' treatment of the ore with a cold solution will extract highly satisfactory percentages of silver values.

It might be argued here that the favorable difference obtained by this last test might be due to the fact that, in using hydrochloric acid instead of sulphuric, more ferric chloride and therefore more chlorides were introduced in the solution than in the first case. I must say, however, that in a second and later set of experiments it was definitely shown that, though there was actually produced a difference by thus varying the composition of the solution, yet this difference was not large enough to account for the wide divergence in the results of the above two tests, so that this variation must be ascribed entirely to the prolongation of time of treatment.

Besides the above ore, other ores and of varying grades in value were tested also, with a view of studying the effects of varying the concentration of ferric chloride and generally to corroborate the above results. These ores ran about thirty-eight, twenty, three and two dollars, total values per ton each, with crushing of eighty, forty and twenty meshes, also one that contained grains as coarse as small peas. I must, however, without going into the details of all those various tests only assert that these additional experiments have led me to draw the following conclusions without any hesitancy.

1. The percentage of extraction of the silver values is of about the same high degree, namely: ninety-five to ninety-seven per cent, whether the solution and ore mass is kept boiling for two or three hours, with constanting stirring, or is left in the cold for two to three days with only occasional shaking.

2. It also does not materially affect the results whether the solution contains only one per cent ferric chloride and is constantly chlorinated, or oxidized in some way and thus regenerated, or is made up of two to three per cent ferric chloride and is left without chlorination. This is so, of course, only so far as the silver extraction is concerned. The thoroughness of extraction of the gold values depends entirely upon the thoroughness of chlorination.

3. By prolonging the time of treatment in cold to three to four days the almost totality of the silver values can be got, provided they occur as sulphide, as chloride or as metal, though this latter is rarely the case in nature.

4. By constant removal by electrolysis of the silver dissolved and consequent regeneration of the solution, and proper stirring of the ore mass, the time of treatment is very much shortened.

5. In most cases, if the ore carries also much gold, a sufficient amount of this metal is also extracted, besides the silver, to pay a large share, if not the whole, of the expenses of the treatment, and this with no more care than is given to the extraction of silver alone.

6. If it be desired to extract the gold values to anything like the thoroughness of the silver, then care must be taken that the solution never lacks chlorine. If this were the case, that is, if any chance were given for the ferrous chlorine, resulting from the action of ferric chloride upon the sulphides in general, to accumulate in the solution to any extent, then the gold, if at all dissolved, would be reprecipitated and would thus remain in the ore mass by the well-known secondary influence of ferrous salts upon the dissolved gold chloride.

7. It does not make a serious difference whether one uses sulphuric acid to acidify the solution with, or hydrochloric acid.

This is so, of course, only so far as the degree of extraction of the total values is concerned. From the economic standpoint, it makes a good deal of difference, as the first named acid is much cheaper than the second one.

From all these data, it follows that silver ores, carrying gold, can be very effectively treated with a solution of the composition above stated, to wit: one to two per cent ferric chloride, fifteen to twenty per cent common salt, and one per cent hydrochloric or sulphuric acid.

The treatment may be carried out in the cold, or in the warm, according to practical facilities. The solution may be left to leach through the ore, kept well stirred and continuously electrolyzed as it leaves the ore vats. It is thus continuously impoverished in values, which are deposited on cathodes, and also continuously regenerated through the oxidizing influence of the chlorine given off during electrolysis. The time of treatment of a given batch of ore would, under such circumstances, be not more than two to three days, if the solution be kept cold, or two to three hours, if it be kept warm.

Nor would such a process be an expensive one, since it is essentially cyclic and the real tool or agent of the reaction, namely, ferric chloride, is readily regenerated by means of the current depositing the values, there is practically no loss to be contended with, other than, indeed, what little amount of hydrochloric acid is used up in furnishing the necessary chlorine, or of salt being converted into sodium sulphate, if sulphuric acid be the acid used. The current itself is hardly of any serious account in oxidizing the solution and simultaneously electrodepositing the values. There may, however, be one item of expense worth mentioning, and that would be, if the ore should happen to be too alkaline to allow the economic use of even as cheap an acid as sulphuric acid to neutralize it with. Such ores, however, I think, are rather rare. Still, even in such cases, a little knowledge of chemical reactions will show that the difficulty is not insuperable. As regards the removal from the solution of the excess of ferric salts which may accumulate in the long run, this may readily be done by utilizing the alcalinity of ores from time to time.

ELECTROLYSIS OF THE SOLUTION AND DEPOSITION OF THE VALUES.

As to the details of the electrolysis of the solution holding the values and of recovering these latter, I have, after several vain attempts, under the most varied conditions, come to the belief that it is useless to worry one's self in trying to get nice coherent deposits from these chloride solutions. If the solution is kept in motion—which is a necessity for continuous work—it is found that a current density of 0.1 ampere per square decimetre, with a voltage of 1.5 to 2 volts, and with platinum electrodes, will not deposit the values on the cathode at all; whereas this same current will succeed in precipitating all the values if the solution be kept quiescent. The reason for this peculiarity lies, I believe, in that the deposit being slimy or spongy and easily rubbed off the surfaces of the cathodes by the solution in motion, the solution has a stronger tendency to redissolve the values than has a current of given density to precipitate them. By increasing the current density, however, the deposition is carried to completion although as slimy as ever.

If, however, a very small percentage (the fraction of a per cent) of glue, or any mucilaginous substance is added to the solution, the character of the deposit obtained is wholly changed. Instead of the loose and black precipitate on the cathode, one now gets, as a rule, especially if the solution be warmed, a good, firm and whitish gray deposit which takes a high polish when rubbed with the handle or back of a knife. Moreover, it now matters no longer whether the solution is left quiescent or stirred vigorously or even kept boiling. The deposit is always good, provided the current density is proper. Thus, by reason of the very fact that this deposit sticks firmly to the cathode, it would seem as if with a small trick like this, one might get good and firm deposits and thus stop the values, once deposited on the cathodes, from falling off into the solution and there be subject to redissolution.

Unfortunately, however, sometimes in spite of the best intentions and care on the part of the operator, the solution refuses to give good deposits, even with the addition of glue. And then the deposit is again slimy and black. For these and other reasons liable to cause possible hitches in the work of the electrolysis, it might be better to have recourse to some mechanical device, whereby the slimy metals on the cathodes may be continuously removed before they have any chance to fall off into the solution.

A handy method in point is one described by Tomassi (*Comptes Rendus Academic des Science de Paris*, vol. cxxii, p. 1476). Briefly described, it lies in that the cathodes are made in form of circular plates, only half of each of which dips in the solution. They are further so arranged that they can rotate at a slow rate, say once or twice a minute. In consequence of this rotation, there is always some new surface being covered with slimy metal deposit, while other portions emerge from the solution already charged. In its motion, the external part of the plate comes against rubber pads provided with long grooves leading to a suitable receptacle near-by. Along these grooves, serving as channels, the slimes, loosened by the rubber pads, are drifted by means of small jets of a dilute solution of salt, and thus carried into the receptacle where the values are collected.

As regards the materials, of which the electrodes may best be made in connection with this work, I may say, that I have tried many metals and found that the carbon or graphite electrodes are the most suitable as regards duration, desirability and also cheapness.

In conclusion, I must extend my grateful thanks to Professor O'Neill and to Dr. F. G. Cottrell, of the department of chemistry of this University,[1] especially to the former, whose kind consideration and good will in affording me facilities for carrying out my work in this line I am enjoying every day in these laboratories.

I must also express my thanks to a personal friend who kindly defrayed the necessary expenses in securing professional assaying connected with part of the work here described.

The Trackless Trolley.

Some figures recently published by the Berlin General Electric Company show that a trackless overhead trolley car, capable of holding twenty-two passengers, uses about the same amount of electric current as an ordinary street car with accommodation for twenty-eight passengers, representing a higher cost of some twenty-five per cent. The maintenance of the trackless cars, owing to the greater wearing out of the rolling-stock and the extensive need of lubricators, etc., is larger than on track cars, though in the latter case provision has to be made for repairs to permanent way. The total operating costs worked out at about fourpence per mile. Figures are also given for the operation of the trackless line in the Bila valley. According to the latest reports, after three months' operation the cost of electric current was double that of a track road. This greater utilization of current, however, is calculated to represent only one-tenth of the sum which track roads require for interest and maintenance. A large part of the income of these trackless roads is obtained by carrying goods. It has been found that the streets are not at all injured by the trackless cars.—*Mechanical Engineer* (*London*).

[1] Mr. Vaygouny is an assistant in the department of chemistry, University of California.

THE NERNST LAMP AS A FACTOR IN COMMERCIAL LIGHTING.[1]

BY E. R. ROBERTS.

The "glower," or the part which gives the light, is the distinguishing feature of the lamp. It is made in the form of a small rod of white, porcelain-like material, about one inch long and one-thirty-second of an inch in diameter. Fastened to each end of the glower are platinum lead-wire terminals. At ordinary temperatures, the glower is practically an insulator, but becomes a conductor when heated to about 700 degrees centigrade. This means, of course, that the resistance constantly decreases as heat is applied. After current starts to flow, no further heating from the external source is necessary, as the I^2R energy, supplied by the current, is not only sufficient to maintain the glower in an incandescent state, but causes the resistance to decrease still further with a consequent increase in current. This cumulative action, if not arrested in time, causes the current to rapidly attain a very high value, and the glower finally breaks down or flashes out. It, therefore, becomes necessary to place in series with the glower a resistance having a positive temperature correction; just opposite to that of the glower. This resistance, which we call the ballast, consists of a very fine wire of pure iron, suitably mounted in a hermetically sealed glass tube, from which the air has been exhausted, and replaced with an atmosphere of hydrogen. This prevents oxidation of the iron and still serves as a medium to conduct the generated heat from the wire. The ballast is so dimensioned throughout that with a rise in voltage above the normal operating point of the lamp, there is a rapid increase of the ballasting resistance. In figures, this amounts to about 140 per cent for a rise of fifteen per cent in line voltage. While this effectually protects the glower against momentary fluctuations of twenty-five per cent above normal lamp voltage, the ballast is liable to injury if the lamp is operated at more than five per cent overload continuously. On well regulated circuits, where the lamp will not be subjected to an overload exceeding five per cent for any length of time, the life of the ballast is practically indefinite and its characteristic and function is not appreciably impaired with age. This can hardly be said of the glower; like all other sources of light, there is gradual decrease in the intensity of the rays emitted. Before being used, the surface of the glower presents a smooth, white, porcelain-like or chalky appearance; after being in service, say 500 hours, this surface is rough and crystalline in appearance. It is this change in the structure of the glower, from an amorphous to a crystalline state, that is supposed to cause a rise in its resistance. The resultant decrease in candle-power, from its rated value on a constant-potential circuit, should not exceed twenty per cent in 800 hours.

In the early part of the life of the lamp there is a decrease in intensity and the rated candle-power value is not reached until after about twenty-five hours' run; for instance, while the rated candle-power of the single glower lamp is fifty, the initial candle-power would average sixty. This initial excess is not contracted for and may be considered as a gift to the consumer.

Being composed of rare oxides, incapable of further oxidation, the glower does not require a vacuum, and, in fact, the presence of as much oxygen as is found in the atmosphere is necessary for its successful commercial operation. In vacuum, the glower is rendered much less stable, and requires a correspondingly greater amount of ballasting resistance. Hydrogen and nitrogen have the same effects in a lesser degree, while the characteristics in air and oxygen are practically identical. Operating on direct current, the glower exhibits all the characteristics of a solid electrolyte, and its life is greatly shortened. Its life may be prolonged somewhat by reversing the current at intervals, which probably accounts for the fact that, when operated on alternating current circuits, the life increases with the periodicity or number of current reversals.

In the automatic lamp, which is the commercial type of lamp now on the market, the glower is brought to a conducting temperature by means of an electric heater, consisting of fine platinum resistance wires, wound on porcelain tubes; the whole being coated with a white, refractory paste which acts as a protection to the windings against the intense heat of the glower, and also as a light-reflecting surface. The heater is thrown in and out of service by an automatic cutout which, in turn, is actuated by the glower current.

Contrary to the practice abroad, the American company has adopted a standard glower, taking 0.4 ampere at approximately 210 volts, and lamps of different intensities are made by varying the number of glowers. In this connection, it may be mentioned that the manufacturers have recently developed, and are about to market, a four-glower lamp, which will have the same external appearance as the present six-glower unit. This lamp will be equivalent, in watt consumption, to that of the standard five-ampere multiple alternating-current lamp, and should prove to be a very popular unit for general commercial lighting.

Two systems of maintenance for the Nernst lamp have been employed. In the one, all the installations within a certain radius are maintained for a fixed sum per month, from a central maintenance bureau which may be directly in control either of the Nernst Lamp Company or the central station on whose circuits the lamps are operating. This department of the lighting company is analogous to the meter department which is now becoming an auxiliary to all well-managed lighting plants. Such an organization involves the services of an inexpensive class of help, consisting of an inspector, who alone, or with one or more assistants in the case of the larger plants, operates the maintenance system, visiting all installations periodically; for example, commercial installations may be visited weekly and residential installations once per month, the user being instructed how to act in contingencies which may arise during the absence of the inspector. A complete stock of Nernst lamp parts is carried in the repair department. The work to be done here is so simple, owing to the careful provision made in the design of the lamp details for easy renewal, that a boy or girl can, in a short time, acquire the necessary skill. In some central stations, where the Nernst business has not yet assumed extensive proportions, the labor item may be reduced to a minimum by having the arc trimmer include the Nernst maintenance in his regular duties.

The second system is especially applicable to the larger installations and those in isolated localities. In these cases the maintenance work may be entirely taken care of by the building janitor or electrician who has previously received some instruction and training, either at the company's works, or from an expert repairman. Suitable quarters would be provided in the building in which a limited stock of repair parts and facilities for renewal work would be available.

The total cost of maintenance under these conditions will be comparatively low, provided the maintenance work is executed in a systematic manner; a certain portion of the day being given to com-

[1] Abstract of a paper read before the Michigan Electric Association, Detroit, Mich., October 12, 1904.

plete inspection of all lamps installed, the repairing of defective holders being afterward done in the repair room.

APPLICATIONS AND PROGRESS.

It is now generally conceded that the color of the Nernst light is closer to that of sunlight than that of any other illuminant, and instead of attempting, at this time, to support this statement by a discussion of spectroscopic data, it may be mentioned that the directors of the fine arts exhibit at the Louisiana Purchase Exposition selected and are now using the lamp to light the Art Palaces. This selection was the result of a series of careful, practical tests to determine which of the modern illuminants was most effective in bringing out the colors applied to the paintings by the artists when sketching from nature by daylight, and in providing the most pleasing general effect. These same remarks apply to the recent decision of the art committee of the Albright Art Gallery in Buffalo, to use the Nernst lamp in their handsome new structure. Naturally, this advantage in color, combined with those of steadiness, economy and neat appearance, would also tend to make it especially adapted to store lighting, and one need not be an optimist to foresee a promising future for the lamp in this particular field. That the lamp is becoming useful to the central station, as a competitor of gas mantle burners, especially in the haunts of artificial gas, is practically demonstrated on the circuits of the largest lighting companies in the country. Not only is this true for interior work; several Nernst installations for street lighting have been made wherein the one-glower lamp has been successfully used in competition with single-burner gas lamps. With reference to street lighting in general, suffice it to say that careful estimates show that the Nernst system involving the use of the six-glower lamp compares very favorably in the results obtained, as well as in cost of generating equipment and maintenance, with a modern alternating-current or direct-current series arc system. As compared with the alternating-current arc system, the Nernst system would have the advantage of 100 per cent power-factor tending toward better regulation. It is also fair to expect a more compact and simple station equipment than would be required in either of the arc systems, particularly in the case of the direct current.

While there have been close on to 400,000 glower units placed in service in the United States for various classes of lighting, it will not be attempted at this time to set forth the special adaptability of the Nernst lamp for each class of commercial lighting. With the exception of stage and electric sign lighting and a few other special uses for light energy, the legitimate field of the Nernst is practically identical to that covered by other modern illuminants.

Since the policy of using the central station as a medium for marketing its product was instituted by the company in the early part of this year, over 100 central stations have adopted and are supplying the lamps on their circuits. Classifying this list with respect to the size of the different cities represented, we find that the illuminating companies of three cities of over 500,000 population, four cities of over 250,000, three cities of over 100,000, seventeen cities of over 25,000 and seventeen cities of 10,000 population have adopted the lamp. Of the total number, about twenty per cent have seen fit to furnish free renewals, putting the lamp out on a flat rate contract basis.

The Opening of the Subway in New York City.

The formal ceremonies connected with the opening of the rapid transit subway in New York city were held on Thursday afternoon, October 27. The exercises took place in the aldermanic chamber of the City Hall. The rapid transit commissioners and their guests assembled in the governor's room, and promptly at one o'clock the march to the aldermanic chamber began. Mayor McClellan led the procession, followed by President Fornes of the Board of Aldermen, and Bishop Greer. The rapid transit commissioners followed, and August Belmont and John B. McDonald entered together. Among those present were ex-Mayor Robert Van Wyck, under whose administration the work on the subway was commenced; the Rev. Father Lavelle, rector of St. Patrick's Cathedral, New York city; Perry Belmont, Edward M. Shepard, Albert B. Boardman, George L. Rives, John D. Crimmins, Cornelius Vanderbilt, H. H. Vreeland, Charles M. Jacobs, Howard Carroll, Paul D. Cravath, J. Edward Simmons, S. Uchida and Dr. Nicholas Murray Butler.

After prayer had been offered by Bishop Greer, an address was made by Mayor McClellan. The mayor then called upon Mr. William Barclay Parsons, the engineer-in-chief of the Rapid Transit Commission.

Mr. Parsons announced that the rapid transit railroad was completed for operation from the City Hall to the station at One Hundred and Forty-fifth street on the west side line.

Mr. Alexander E. Orr, president of the Rapid Transit Commission, made a lengthy address, accrediting each of the officers of the company and the directors for the work that had been done.

Mr. John H. Starin, vice-president of the Rapid Transit Commission, then spoke and he was followed by John B. McDonald, the contractor in general.

Mr. August Belmont, president of the Interborough Rapid Transit Company—the company which operates the subway system—followed Mr. McDonald.

Directly after the ceremonies the mayor, the Rapid Transit Commission, officers of the Interborough Rapid Transit Company, and invited guests entered the City Hall station of the rapid transit system and embarked on a special train for the official inspection. Mayor McClellan acted as motorman, using a silver lever presented by Mr. August Belmont to operate the controller.

At 2.30 o'clock the system was thrown open to those who had been fortunate enough to secure invitations from the Interborough Rapid Transit Company and the Rapid Transit Commission, and some 50,000 availed themselves of this opportunity. At seven o'clock Thursday evening the system was thrown open to the public and the sale of tickets begun. From Thursday evening, up to midnight, the number of passengers carried was 111,881. The proceeds of this traffic were awarded the hospitals of the city by the direction of Mr. Belmont. By midnight on Friday there had been 350,000 passengers carried. Everything seemed to be in perfect working order, and with the exception of a few slight hitches due to minor breakdowns, the operation was all that could be asked for.

On Thursday evening the directors of the Interborough company gave a dinner to Mr. August Belmont, at Sherry's, New York city, to celebrate the opening. Mr. Walter G. Oakman presided. Speeches were made by Mr. Oakman, Mr. Belmont, Mayor McClellan, Jacob H. Schiff, Alexander E. Orr and Morris K. Jesup. Before the dinner a loving cup was presented to Mr. Belmont by the board of directors.

The mayor spoke briefly, and recounted how his father, General George B. McClellan, and the first August Belmont were associated in 1884 in a plan which failed, to build a tunnel up Broadway. The unpledged margin of the city's debt limit, amounting to something like $40,000,000, he said, should be used for additional water supply and additional rapid transit.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Vertical and Horizontal Spindle Milling Machine.

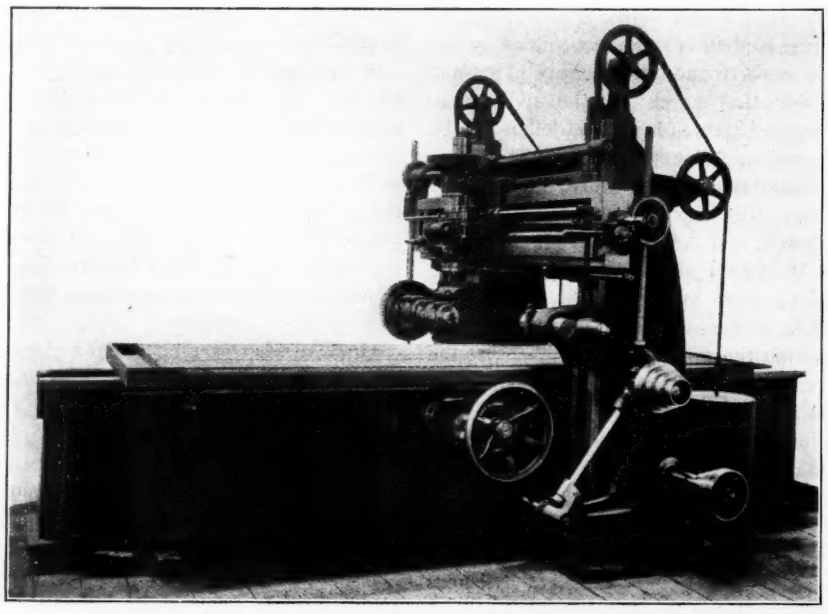
The accompanying figure illustrates a vertical and horizontal spindle milling machine, which the Newton Machine Tool Works, Philadelphia, Pa., has recently designed and built.

Both spindles of this machine are four inches in diameter, and are driven by a cone or motor as the case may be, but are so clutched that they may be operated independently of each other or simultaneously.

The horizontal spindle has a vertical adjustment on the upright of sixteen inches, and has an in-and-out adjustment of three inches for convenience in setting cutters. The vertical spindle has a cross-feed in either direction on the rail with an automatic stop to the feed which may be adjusted to the upright at any desired point.

The spindle has an independent, vertical adjustment of five and one-half inches, and the cross-rail, which is counterweighted, is raised and lowered by hand (or power if desired) from the splining shaft and spiral gearing shown in the cross-rail. There is a quick clamping device for locking the rail in position which is operated by the shaft shown directly under the cross-rail.

The maximum height under the vertical spindle is twenty-five inches, and the maximum distance from centre of horizontal spindle to table is seventeen inches; it will admit work thirty-six inches wide between the nose of the horizontal spindle and the upright, and forty-five inches wide between uprights; the carriage is thirty-five inches wide to mill twelve feet long, and can be made to mill any desired length; has four changes of automatic feed and power, and quick traverse in either direction. The machine is also fitted with an automatic feed for stop.

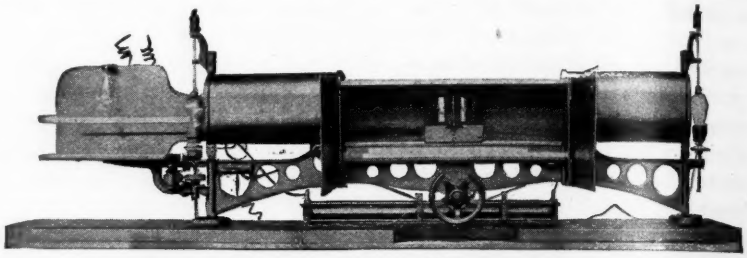


VERTICAL AND HORIZONTAL SPINDLE MILLING MACHINE.

The Standard Station Photometer.

The accompanying illustration shows the standard station photometer manufactured by the Dwyer Machine Company, Lynn, Mass. This instrument is intended especially for the testing of incandescent electric lamps by the consumer. The device is an embodiment of features conforming to approved practice in lamp factories, lighting stations and testing laboratories.

The frame is of cast iron, carefully machined, which ensures a perfect alignment and unalterable accuracy. The fittings are of the highest quality of material and workmanship, and the designs have been proved to be efficient with constant use. The car is well enclosed, which, while necessary during the operation, protects the vital parts from injury and dust when not in use. The instrument is adapted to be set on wall brackets or on a bench, and it is also furnished mounted on pedestals. All of the wiring is accessible, and the binding-posts and flexible connections are provided for volt and ammeters.



"STANDARD" STATION PHOTOMETER.

The rheostat is of the sliding type, and controls both the main circuit and the standard lamp independently, and makes possible the finest fractional adjustment of potential. The rheostat is ample in size, and is wound with an imported German silver wire, which remains practically neutral under changes of temperature.

The working socket is rotatable by means of a motor, or from a power shaft by means of a round belt. A clutch, which can be operated by either the hand or the foot, starts and stops the socket instantly at will for removing or placing a lamp. The standard lamp is adjustable for height, but the distance between the lamps is fixed.

The car is of the Bunsen type, and the screen is reversible and can be readily removed. The car is operated by means of a hand-wheel, and the car track is machined on the frame similar to the bed of a lathe.

The scales read directly in candle-power and cover a range of from one and one-half to sixty-four candle-power. When specified, an auxiliary scale is provided, which enables the operator placing the lamps to also take the readings.

The Dwyer Machine Company also manufactures isolated plant photometers, portable photometers, laboratory photometers, and special lamp factory photometers.

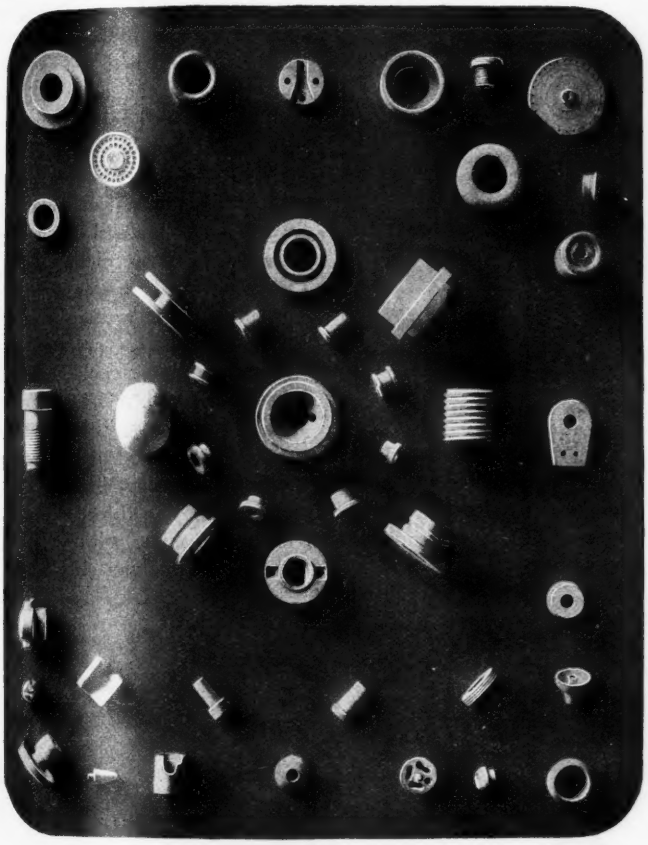
Lava for Mechanical and Electrical Purposes.

The accompanying illustration shows a number of parts made up from the well-known material which has been designated as "lava." This material is not, as is frequently supposed, a natural product of volcanic origin. It is a mineral talc which has been machined in its natural condition and then baked under certain conditions of time and temperature until it has become thoroughly hard.

The material, being baked at a temperature of 2,000 degrees, is unaffected by subsequent temperatures short of that heat. This material fuses with difficulty under a strong blast flame, and has exceptional stability under the electric arc. It is only slowly dissolved by hydrochloric acid, and is not easily affected by other acids or alkalies. It is free from metal oxides or other impurities, which promotes its insulating value.

The material, before being baked, is sawn, milled, drilled, turned and threaded in much the same manner as brass, and with practically the same character of tools. For most work and for pieces of bulk, the method of baking is much the same as with porcelain, where coal and coke ovens are used; while with pieces of moderate size, and especially where close control of temperature is desired for the purpose of extreme accuracy and uniformity, the electric furnace or gas blast furnace is employed.

Under tests for dielectric strength, made with transformers of large capacity, and with carefully calibrated electrostatic voltmeters, this material has demonstrated a uniform ability to withstand high potentials. Its dielectric strength is expressed as from 75 to 250 volts per thousandth of an inch thickness, depending upon the absolute thickness of the sample tested.



Lava Products for Mechanical and Electrical Purposes.

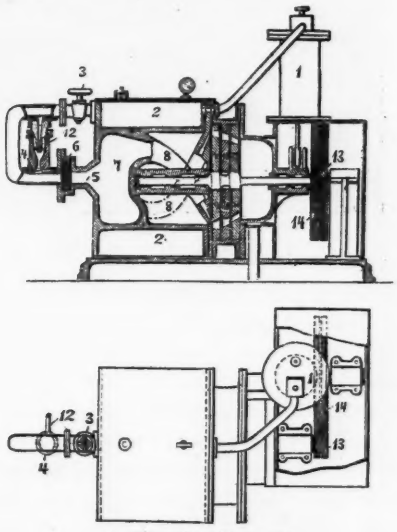
This material is being placed upon the market by the American Lava Company, Chattanooga, Tenn.

Electrical Committee of the Underwriters to Meet.

The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held in New York city on December 7, at the rooms of the New York Board of Fire Underwriters. Reports of committees and suggestions for changes in the national electric code will be the main feature of the meeting. Mr. H. C. Eddy, of Chicago, Ill., is president of the association.

A New Gas Turbine.

In the gas turbine of Charles Lemale, of Paris, a chamber for collecting the burnt gases is inserted between the injector, which supplies the mixture of air and gas continuously and uniformly to the combustion chamber, and the rotor of the turbine. The size of the collecting chamber is so chosen that the pressure of the burnt gases is equal to the pressure they possess before combustion. Thus the combustion causes only an increase of the volume and no rise of the pressure. The regulation of the turbine is effected by changing the pressure of the gases before entering the nozzle and with it that of the burnt gases in the collecting chamber. The machine consists of an air pump 1, the piston of which is actuated

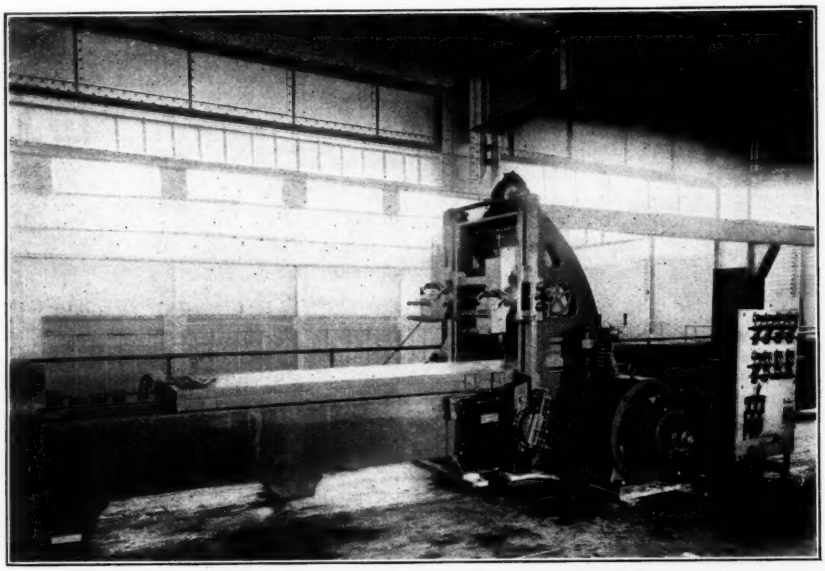


A New Gas Turbine.

through the small slot 13 by the cog-wheel 14; an air reservoir 2 around the collecting chamber; an ejector 4; a collecting chamber 7; channels 8, and the turbine 9, 10 and 11. The manner of operation is as follows: the air compressed by pump 1 is led through reservoir 2 and valve 3 to the injector 4, where it draws in and is mixed with the gas entering through pipe 12. The mixture is led through the metal screen 6 to the combustion chamber 7, is ignited by the igniter 5 and expands without change of pressure in chamber 7. From here the gas flows under expansion through the channels 8, the number of which is chosen according to the requirements of working, to the turbine, which it sets in motion. The uniform supply of the fuel prevents any inadmissible rise or lowering of the temperature. The continuous flow of the gases through the nozzle produces a uniform lowering of pressure. The pressure in the combustion chamber differs very little from the initial. From the second turbine the gases are exhausted without pressure.—*Electrotechnische Rundschanft, September,* 1904.

Improved Motor Drive for Planers.

The Electric Controller and Supply Company, Cleveland, Ohio, has designed a system of direct motor drive for planers, for which it claims features of exceptional merit. In the accompanying illustration



THIRTY-SIX-INCH POND PLANER, EQUIPPED WITH DIRECT MOTOR DRIVE.

is shown a thirty-six-inch by thirty-six-inch by twelve-inch Pond planer equipped with a direct-motor drive, with speed controllers for both cutting and return motions. The motor used in this instance is a Westinghouse type "S," three-wire, variable-speed, compound-wound machine. With the old-time system of belt drive from a line shafting, the planer was one of the most inefficient machine tools. In many cases only a single cutting speed was provided, and this speed was too low for cutting cast iron at maximum efficiency, and too high for cutting tool steel without a rapid depreciation on the tool. With the advent of the motor drive the situation was improved in connection with clutches, and by the introduction of change gears. With the idea in view of eliminating the difficulties which obtained with these former drives, the Electric Controller and Supply Company has designed this system, so that a planer operator can adjust the cutting speed to suit the requirements of the work in hand.

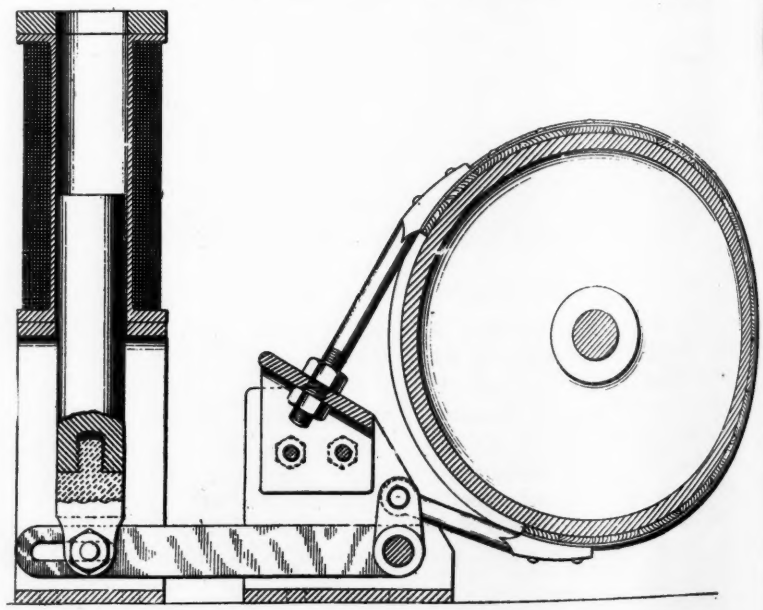
The outfit consists of a reversing switch attached to the body of the planer, and operated by a pair of dogs, adjustably mounted on the side of the platen. There is a speed controller for the cutting speed, and one also for the return speed, if desired. In addition, there is an accelerating controller with its resistance.

By the use of this system the company states the planer operator can get instant adjustment of speed for cutting from sixteen to eighty feet per minute, in steps of four feet, and return speeds of from four to eighty feet per minute, in steps of about four feet. This condition is for the Pond planer illustrated herewith, with the compound-wound motor on the three-wire system. For the two-wire system, variations in cutting speed from sixteen to forty feet, with return speed the same, can be secured. In other words, with the three-wire system variations in cutting speeds can be had in the ratio of five to one, and with the two-wire system, in the ratio of two and one-half to one.

A New Magnetic Brake.

Mr. Jacob F. Motz, of Phœnixville, Pa., has invented and patented a new form of magnetic brake, an illustration of which is shown herewith. The object of this invention is to provide a magnetic brake in which the actuating magnet will hold the armature when the mechanism is subjected to light loads, and especially when a series-wound magnet is used.

The accompanying figure shows the apparatus partly in section. Upon a shaft is mounted a friction drum, this being engaged by a brake strap. The brake strap is secured at one end with a link pin, and on the other end with a pin which is passed into a standard and adjusted by two lock-nuts. The link pin securing the lower end of the brake strap is actuated by a bell crank lever which works in a standard which is secured to the whole device by a proper form of pedestal. The major arm of the bell crank lever is actuated, in turn, by a plunger which is operated through the medium of a solenoid mounted upon a second pedestal. At the lower end of the plunger there is a threaded hole which is engaged by a head of non-conducting material, preferably brass. This head is provided with a threaded boss for making intimate contact with the lower end of the iron armature or plunger. At the top of the solenoid there is placed a ring of magnetic material, such as soft steel or iron.



MAGNETIC BRAKE.

The method of operation of this device is essentially as follows: the solenoid, being energized by sending a current

through the winding, draws up the plunger, which action releases the brake through the medium of the lever and link pin. The soft-steel ring surmounting the solenoid acts as a pole-piece, and serves to localize the magnetic lines of force, thereby enabling the armature to be held up by comparatively little expenditure of energy. The threaded head at the lower end of the plunger, being of a non-magnetic substance, is not attracted by the solenoid; therefore, when the plunger moves upward until the lower end of the iron member is substantially flush with the lower end of the solenoid, the magnetism has no further tendency to raise the lever. There is, therefore, between the lower end of the armature and the lever an intervening space in which there is no magnetic material, so that, when the armature moves upward to a certain predetermined point, this upward movement is discontinued.

The brake is applied to the wheel by the weight of the plunger due to the release of the armature by the solenoid. In this apparatus, of course, when the brake is not applied a current normally flows continuously through the solenoid.

A New Form of Incandescent Lamp Socket Ring.

The H. W. Johns-Manville Company, 100 William street, New York city, claims several advantages for its patented "Electrobestos" incandescent lamp socket ring. This is a new device, and the manufacturer claims is fireproof and practically non-breakable. This adapts it particularly to street railway and steamship service. "Electrobestos" socket rings will not melt, neither will they break through vibration or because of atmospheric changes. Their non-conducting properties have been established in a breakdown test of 2,000 volts.

NEW FORM OF INCANDESCENT LAMP SOCKET RING.

The Awards to the Westinghouse Companies at the Louisiana Purchase Exposition.

The Westinghouse Companies at the Louisiana Purchase Exposition have announced the following awards:

There was a special award in the department of machinery for "the best, most complete and most attractive installation."

There were twelve grand prizes, as follows:

To the Westinghouse Electric and Manufacturing Company, for "alternating-current generators and motors, alternating-current turbo-generator installation, static transformers, and rotary converters"—Group 67.

To the Westinghouse Electric and Manufacturing Company, for "direct-current generators and motors"—Group 67.

To the Westinghouse Electric and Manufacturing Company, for "electric railway motors, alternating-current and direct-current, and control systems for single and multiple unit operation and for mining and industrial locomotives"—Group 67.

To the Westinghouse Machine Company, for "horizontal gas engines and steam turbines"—Groups 62 and 63.

To the Westinghouse Air Brake Company, for "air brakes and friction draught gears"—Group 74.

To the Westinghouse Traction Brake Company, for "brakes for electric cars"—Group 74.

To the American Brake Company, for "driver brakes"—Group 74.

To the Westinghouse Automatic Air and Steam Coupler Company, for "air and steam couplers"—Group 74.

To the Westinghouse Brake Company, Limited, London, England, for "air brakes and accessories"—Group 74.

To the Westinghouse Company, Limited, of St. Petersburg, Russia, for "air brakes and accessories"—Group 74.

To the Union Switch and Signal Company, for "signal system"—Group 74.

To the Cooper Hewitt Electric Company, for "the development of the mercury vapor arc lamp"—Group 69.

There were eight gold medals awarded, as follows:

To the Westinghouse Electric and Manufacturing Company, for "complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes"—Group 67.

To the Westinghouse Electric and Manufacturing Company, for "alternating-current, direct-current, and Bremer arc lamps and arc-lighting systems"—Group 69.

To the Westinghouse Electric and Manufacturing Company, for "electric measuring instruments"—Group 71.

To the Nernst Lamp Company, for "Nernst lamps"—Group 69.

To the Cooper Hewitt Electric Company, for "vapor lamps for photo-engraving"—Group 15.

To the Pittsburg Meter Company, for "water and gas meters"—Group 64.

To the Westinghouse Electric and Manufacturing Company, for "industrial betterment work"—Group 138.

To the Westinghouse Air Brake Company, for "the housing of the working classes"—Group 136.

Four silver medals were awarded, as follows:

To the Westinghouse Electric and Manufacturing Company, for "switches, fuses, and wiring appliances"—Group 69.

To the Sawyer-Man Electric Company, for "incandescent lamps"—Group 69.

To the Bryant Electric Company, for "electric light fittings"—Group 69.

To the Société Anonyme Westinghouse, Havre, France, for "gasoline automobiles"—Group 72.

One bronze medal was awarded:

To the Perkins Electric Switch Manufacturing Company, for "electric switches"—Group 69.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LARGE MORTGAGE FILED—The New York, New Haven & Hartford Railroad Company has filed a mortgage for $15,000,000 in the Westchester County register's office, at White Plains, N. Y. The mortgage is jointly given by the New Haven and the Harlem River & Portchester Railroad Company to the United States Trust Company of New York.

NEW EQUIPMENT FOR THE VALLEY COUNTIES POWER COMPANY—The Valley Counties Power Company has recently completed the installation of an additional dynamo with a capacity of 6,000 horse-power, at the de Sabla power-house, Centreville, Cal. The water used at this plant is secured from Butte creek, and is brought to the power-house by a pipe line about half a mile long. The new unit is supplied by an additional pipe line from the dam to the power-house.

CHICAGO TO BOSTON BY TROLLEY—A road now building between Benton Harbor and Kalamazoo, Mich., when completed in 1905, it is said, will provide trolley transportation from Chicago to New York and Boston. The last gap in the trunk line is being constructed from Kalamazoo, which will make a direct line between Benton Harbor and New York. The spread of the Michigan lines is due to a fight between the Pere Marquette road and the Graham & Morton Steamship Company. The line to New York will carry freight and passengers.

PUBLIC SERVICE CORPORATION PLACES LARGE TRUST ISSUE—The directors of the Public Service Corporation, which controls a large number of traction and lighting companies in the northern part of New Jersey, have authorized the creation of $7,500,000 five per cent five-year collateral trust bonds, secured by about $11,500,000 bonds of subsidiary corporations. The entire issue has been sold to Robert Winthrop & Company, of New York city. The proceeds of the sale will be devoted to the extension and improvement of the company's various power and gas plants and rolling stock.

OHIO HOLDING COMPANY INCORPORATED WITH LARGE CAPITAL—The Columbus, Delaware & Marion Railway Company has been incorporated under the laws of Ohio with $2,500,000 capital stock. The new corporation will be a holding company, taking over the stock of the following: Columbus, Delaware & Marion Electric Railway Company, capital stock $1,666,666; Marion Railway, Light and Power Company, $500,000, and the Columbus Northern Railway, Power and Equipment Company, $300,000. John M. Webb, of Springfield, Ohio, is president; M. J. Catrow, Miamisburg, Ohio, treasurer, and Walter Black, Columbus, secretary of the holding company.

NEW TELEPHONE TRUNK LINES—The Consolidated Telephone Companies of Pennsylvania, with a system of exchanges extending from McKeesport to Norristown, have entered into negotiations for the sale of their properties to the United States Telephone Company, whose plan is to establish a trunk line from New York, *via* Philadelphia, to Chicago. Under the plan the United States company is to come into possession of the independent exchanges at Norristown, Reading, Allentown, Scranton, Wilkesbarre, Mauch Chunk, Harrisburg, Altoona and McKeesport, all having connection with the Keystone, of Philadelphia, and also with the independent Knickerbocker, of New York, by way of the cross-Jersey lines.

NEW POWER-HOUSE FOR FORT WAYNE TRACTION COMPANY—At a recent meeting of the officials of the Fort Wayne & Wabash Valley Traction Company, the Fort Wayne Light and Power Company and its tributary properties, improvements were decided upon. It was determined to erect in Fort Wayne a power plant to cost between $800,000 and $1,000,000. It will be of sufficient size to supply power for the city traction lines, local light and power companies, the interurban lines as far west as Logansport, and for new lines contemplated east, north and south. It is proposed to abandon the Spy Run avenue station and its water power. The new power-house will be in touch with the railroad, so as to be able to receive coal direct from the cars.

TEST OF THE NEW YORK CENTRAL ELECTRIC LOCOMOTIVES—On the morning of October 27 the first tests were made of the electric locomotives which the General Electric Company is building for the New York Central & Hudson River Railroad Company. A speed of about fifty-five miles an hour was attained, but no attempt at high speed was made. The test was rather informal in nature, but was witnessed by Mr. William K. Vanderbilt, Jr., W. J. Wilgus, chief engineer of the New York Central, and E. B. Katte, electrical engineer for the company. The test was made on a strip of track four miles long. It is understood that the speed and acceleration tests were very satisfactory, and that everything which has been claimed for the new electric locomotive will be realized.

CHICAGO TO HAVE SUBWAY—A comprehensive subway system for Chicago will be started before April, 1906, according to Alderman Milton J. Foreman, chairman of the transportation committee of the city council. The system, as outlined by Mr. Foreman in an address at the real estate board banquet on the evening of October 27, will extend as far south as Twelfth street, as far north as Chicago avenue and as far west as Halstead street. The subway will accommodate through traffic. The tunnel, if the present plans are carried out, will be divided into four compartments. Two of these will be for railways, the others for such public utilities as heating and refrigerating plants, high-water pressure pipes and electric wiring. The present river tunnels will be utilized in the new system, while the cars after leaving the subways will be run either on elevated structures or through alleys.

EXTENSIVE POWER PLANTS FOR THE SOUTH—Large electrical developments are under way to take advantage of the power of the Yadkin river, in North Carolina. One company contemplates the building of a dam 1,500 feet long, fifty-eight feet wide and thirty-eight feet high. An investment of $5,000,000 will probably be required, and it is purposed to develop 46,000 horse-power. This power will be transmitted to various counties for the operation of manufacturing and mining industries and other enterprises. Another company has been organized to develop about 8,000 horse-power from Bath, Maddox and Glen Shoals, on the Savannah river. Surveys are now being made for the development of Ring Jaw shoals by South Carolina and New York capital. A company has been formed at Chester, which has purchased a site on the Broad river, North Carolina, and arrangements are being completed for the development of its water power.

NEW LINE FOR COLORADO—Additions will be made to the Denver City Tramway Company's system to extend the lines to Pueblo, Col. Surveys for the new lines have been made, and plans for the bonded indebtedness of the road are being completed. The cost of construction and equipment is placed at $10,000,000, but it is reported that the bonded indebtedness, added to the preferred and common stock, will reach almost $25,000,000. The plans contemplate the bringing of freight and passenger cars into the city of Denver. Part of the project is to make the running time between Denver and Manitou—about eighty miles—in one hour, and to cover the distance between Denver and Pueblo—125 miles—in an hour and twenty-five minutes. The new trolley system will run in almost an air line south from Englewood to Colorado Springs and Pueblo, with a spur to Manitou. At points where it intersects steam roads bridges will be built, so that the other tracks will be spanned and there will be no stops between Denver and Colorado Springs, and none from there on to Pueblo.

THE UNDERGROUND ELECTRIC OF LONDON—In the annual report to the stockholders of the Underground Electric Railway of London, England, Chairman Charles T. Yerkes makes some inter-

esting statements. The power-house which will supply the energy for the operation of the Metropolitan District Railway, the Great Northern, Piccadilly & Brompton Railway, the Baker Street & Waterloo Railway, and the Charing Cross, Euston & Hampstead Railway, is nearing completion. Three-fourths of the machinery has been delivered, including two of the turbo-generators which are now being erected. It is expected that tests of the machinery will be made early in November. The boilers and switchboards have been installed, and all the steam and electrical connections have been made. The ducts and cables forming the transmission line to Earl's Court have been laid and connected. It is proposed to take steps to raise £850,000 on the security of the power-house. New rolling stock, made entirely of non-inflammable material, has been ordered, and deliveries are contracted for during the months of November and December.

MERGING OF CALIFORNIA ELECTRICAL ENTERPRISES—A movement is on foot to consolidate all the lighting and power plants of Santa Cruz and Watsonville, Cal., with the ultimate purpose of merging them into a company, which will include the lighting and power companies and certain street railways of San Jose. The first move toward the accomplishment of this undertaking was made several weeks ago when the electric street railways of Santa Cruz were consolidated. The same persons who were involved in this scheme are reported to be the main factors in the greater one now being quietly carried out. The stockholders of the different corporations have already given an option on their stock and it is reported that the deal will be consummated through the medium of a San Francisco trust company and a law firm of that city within the next thirty days. In the deal there are included the gas companies of Santa Cruz, as well as three electric lighting companies. It is the intention of the absorbing company to establish electric railway connection between San Jose and Santa Cruz and way points, and eventually extend the present lines from Santa Cruz to Monterey. With these connections effected and with the extension of the San Mateo electric line to San Jose, which is said to be under consideration by the United Railroads of San Francisco, a through electric line will soon be operated between the San Francisco and Monterey bays.

MERGER OF THE PORTLAND, ORE., STREET CAR LINES—It is announced a change has been effected and all trolley lines formerly operated by the City & Suburban and the Portland Railway companies are now working under a single management. Meetings of stockholders and election of officers are soon to be held. According to the legal documents which have been filed at the Multonomah County Courthouse, the incorporators are A. L. Mills, J. C. Ainsworth and C. A. Dolph, and the capital stock, which is $5,000,000, is divided into 50,000 shares at a par value of $100 each. Public sale of stock is permitted by the terms of the company, and Messrs. Mills and Ainsworth are empowered to open books and accounts for such sales. The articles of incorporation announce that it is the object of the company to purchase or otherwise acquire, equip and operate street railway lines in Portland and the surrounding country, connecting near-by cities with Portland and traversing Multonomah County; to construct and operate power plants for the generation and sale of electric power; to construct and operate telephone and telegraph lines, and to maintain and conduct parks, pleasure resorts and places of amusement. All of these objects are incidental to the management of a modern trolley system, and the new company plans to branch out in the various directions stated. The merger represents City & Suburban capital to the amount of $2,500,000, and of the Portland Railway Company amounting to $1,500,000, making a total of $4,000,000. The two companies which now enter into the new organization represent 112 miles of tracks and several hundred cars.

TELEPHONE AND TELEGRAPH.

FARGO, N. D.—A telephone exchange is to be established at Westhope.

TRENTON, N. J.—A ten-mile telephone line will be built from Egg Harbor to Green Bay.

PRESTON PARK, PA.—A new telephone line is in course of construction between this place and Stanton Hill.

GREAT FALLS, MONT.—Work will be commenced at once on the line of the Cascade County Rural Telephone Company.

YELLOW PINE, ALA.—A contract has been closed with N. B. Bryan, of St. Stephens, for the erection of a telephone system.

SHERMAN, TEX.—The Grayson County Telephone Company has begun the construction of a line from Pottsboro to Denison.

OXFORD, CT.—The Southern New England Telephone Company is about to make extensions to its lines reaching the farming districts.

SHUSAN, VT.—The Granville Telephone Company has completed a line from East Salem to Shusan. An extension will be made to West Sandgate.

DUNWOODY, GA.—A telephone line has been run from Morgan falls electric works to Chamblee, Ga. It connects with the telephone office at Dunwoody.

IROQUOIS, S. D.—The local telephone company has sold its system to the Dakota Central Telephone Company, which will operate it in future. The system was installed about a year and a half ago by local business men.

DELAWARE, OHIO—The Citizens' Telephone Company has completed work on a line from Stratford to Delaware. A large number of subscribers have already been secured, and it is very probable that the line will be extended further south.

WACO, TEX.—The Southwestern Telegraph and Telephone Company has completed arrangements for putting a telephone exchange in the city of Lorena. The new exchange will be connected with the long-distance service and the subscribers will thus be able to communicate with all important points in the state.

JACKSON, MISS.—The Cumberland Telephone Company is making some very extensive improvements throughout the state, enlarging its exchanges at different points and constructing new lines. The company has been granted a franchise to enter Lexington, Miss., and will begin at once the erection of an exchange in that city.

LITTLE FALLS, N. Y.—The American Construction and Trading Company, of Elyria, Ohio, has purchased a half interest in the Interstate Telephone Company, of this city, for the purpose of making a link in a cross-state long-distance independent telephone service. Irving H. Griswold, of Albany, represents the new purchasers.

NEW HAVEN, CT.—The Southern New England Telephone Company has begun the installation of 30,000 feet of underground conduits in Waterbury. The company is burying its wires in all the large cities of the state, and the conduits in Waterbury will be laid in the principal streets in order to remove the wires from overhead.

CLEVELAND, OHIO—The Cleveland Telephone Company reported to the board of public service recently that with the completion of the 400-pair cable to the New England Building, it had completed the laying of 142 miles of underground cable in the downtown streets of the city. In the cable so laid there are stretched 35,730 miles of wire.

RISING SUN, MD.—Work has been commenced on the construction of the line of the Cecil Farmers' Telephone Company. The line will be run from Rising Sun to Port Deposit and secure connections there with the Maryland Telephone Company for long-distance service. It is the intention to develop the service throughout Cecil County as rapidly as possible. The company was granted a charter by the last session of the legislature at the instance of the Cecil Farmers' Club, whose members constitute the board of directors. The exchange will be located at this town.

SPOKANE, WASH.—Direct communication between Spokane and Seattle will soon be established by the Pacific States Telephone and Telegraph Company. It is announced that a double-wire circuit will be completed between the two cities by filling in a gap of eighty miles along the Great Northern in the mountains. The line will be used solely for through business, and will be about 375 miles long. Telephone communication with the Sound cities is now made *via* Portland, a distance of 600 miles. New telephones will also be installed throughout this city.

NEW INCORPORATIONS.

TOPEKA, KAN.—Lyons Telephone Company. $12,000.

BARNUM, IOWA—Barnum Telephone Company. $10,000.

WARREN, OHIO—The Phœnix Electric Company. $5,000.

TOPEKA, KAN.—Washington Telephone Company. $2,500.

CHANDLER, IND.—Chandler Telephone Company. $10,000.

YUTAN, NEB.—Wayne Independent Telephone Company. $15,000.

SELMA, ALA.—The Maplesville & Selma Telephone Company. $40,000.

HOLT, MO.—Holt Telephone Company. Increased from $10,000 to $30,000.

WASHINGTON, KAN.—The Washington Mutual Telephone Company. $2,500.

DECATUR, ILL.—The Bloomington, Clinton & Decatur Electric Railroad. $50,000.

LANSING, MICH.—Shiawassee & Genesee Mutual Telephone Company. $10,000.

FORT SMITH, ARK.—Fort Smith Light and Traction Company. Increased to $1,000,000.

VALPARAISO, IND.—Northwestern Telephone Company. Increased from $15,000 to $50,000.

CENTERBURG, OHIO—Central Ohio Telephone Company. Increased from $10,000 to $50,000.

COLUMBUS, OHIO—Toledo Urban & Interurban Railway Company. Increased from $100,000 to $1,000,000.

MANCHESTER, N. H.—The Rockingham Light and Power Company. Increased from $750,000 to $1,000,000.

LITTLE ROCK, ARK.—The Fort Smith Light and Traction Company. Increased from $300,000 to $1,000,000.

CHESTER, ILL.—Chester Light and Ice Plant. $10,000. Incorporators: Harvey Neville, Louis P. Gilster, A. G. Neuling.

BOTKINS, OHIO—The Botkins Telephone Company. $20,000. Incorporators: S. H. Mendenhall, Charles Eisley, F. Baughman and others.

EATONTON, GA.—Putnam Mills and Power Company. $75,000. Incorporators: James B. Floyd, Thomas B. Floyd, O. B. Nisbet and others.

DES MOINES, IOWA—The Eldora, Rough Woods & Point Pleasant Telephone Company. $10,000. Incorporators: E. H. Sheldon and others.

WILMINGTON, DEL.—Delaware Water Improvement Company, to conduct power waterworks and an electric light plant at New Castle. $150,000.

SONORA, CAL.—Tuolumne Electric Company. $200,000. Directors: R. W. Hersey, C. W. Juiltz, P. J. Dunne, Philo Hersey and George Keffel.

PATCHIN, N. Y.—Boston Valley Telephone Company. $2,000. Incorporators: L. G. R. Whiting, John W. Gasper, Patchin; F. A. Wurtz, Boston, N. Y.

EASTBROOK, ME.—Eastbrook Telephone Company, Limited. $2,000. President, S. S. DeBeck, Franklin, Mass.; treasurer, R. B. Laurie, Eastbrook, Me.

ITHACA, N. Y.—Ithaca & Cayuga Height Railway. $50,000. Incorporators and directors: Jared Y. Newman, Charles H. Blood, Charles H. Bull, Ithaca.

WASHINGTON, D. C.—National Telephone and Electric Company. $100,000. Incorporators: B. F. Wasson, Ernest W. Porter and E. Richard Shipp.

MINNEAPOLIS, MINN.—Pacific Power Company. $1,000,000. Incorporators: George E. Maxwell, George B. Darling and Sidney R. Mattier, all of Minneapolis.

MADISON, WIS.—Oshkosh & Western Electric Railway Company. $100,000. Incorporators: J. H. Potter, Clement C. Smith, George Hilton and C. C. Morris.

DOVER, DEL.—Fairfield & Olney Traction Company. $300,000. Incorporators: John Absher, Olney, Ill.; Adam Grimes, Fairfield; William S. Lambert, Reading, Pa.

DEFIANCE, OHIO—Valley Power Company. $10,000. Incorporators: H. D. Bokop, John F. Frost, T. T. Ansberry, M. W. Steinberger and Henry B. Harris.

JACKSON, TENN.—The Jackson Light and Power Company. $25,000. Incorporators: F. B. Fisher, I. B. Tirgrett, C. S. Baird, A. K. Jobe, E. L. James and John W. Buford.

PROSPECT, OHIO—The Prospect Electric Light and Power Company. $10,000. Incorporators: George Whysell, W. A. Block, J. S. Webb, A. L. Neereamer and J. W. Pettey.

CAMDEN, N. J.—The United Power and Water Development Company. $100,000. Incorporators: Charles H. Royal, Thomas Craig, D. B. Dance, J. R. Fell and Joseph Cotter.

AUGUSTA, ME.—Commonwealth Light and Heat Company, organized for the purpose of operating electric plants. $1,500,000. President and treasurer, I. L. Fairbanks, of Augusta.

DOYLESTOWN, PA.—West Telford Electric Light and Power Company. $10,000. Incorporators: Henry J. Wambold, West Telford, Pa., and M. A. and M. E. Clymer, both of Sellersville.

ALBANY, N. Y.—The Tottenville Lighting Company, to furnish light, heat and power in Richmond County. $25,000. Directors: William E. Cook, Walter H. Gahagan, John F. McCarthy, Brooklyn.

JEFFERSON CITY, MO.—Missouri Independent Telephone Company. $10,000. Incorporators: Logan Woodson, Paschal Parker, Samuel H. Woodson, Thomas A. Henderson and John A. Eby, Liberty.

KANSAS CITY, MO.—Kansas Telephone Construction Company. $75,000. Incorporators: James S. Bailey, Jr., of Toledo, Ohio; Edward L. Barber, of Wauseon, Ohio; O. C. Snyder, W. C. Polk and Hugh C. Ward.

HOOSICK FALLS, N. Y.—Hoosick Falls Generating Company, to generate gas and electricity. $25,000. Directors: E. R. Case, of New York city; W. Z. Roberts, of Beverly, N. J., and C. P. Fitch, of Deal Beach, N. J.

DENVER, COL.—El Paso Telephone Company, to build lines in the counties of El Paso, Teller, Fremont, Pueblo, Douglas and the city and county of Denver. $500,000. Incorporators: M. H. Spere, N. B. Hames and C. D. Taylor.

NIAGARA, N. Y.—Suburban Power Company. To manufacture electricity for producing light. $10,000. Incorporators: Nathaniel Rochester, James Sweeney, Jr., Buffalo, N. Y.; George W. Davenport, Niagara Falls, N. Y.

CHICAGO, ILL.—Lyons Belt Railroad Company, to be constructed from Lyons to Proviso, in Cook County. $50,000. Incorporators and first board of directors: Frederick Schultz, F. C. Schultz, Lyons; George Allen, W. S. Joslyn, F. F. Heck, Chicago.

MANCHESTER, ME.—Woodland Telephone Company. $10,000. President, F. S. Collins, Manchester, Me.; treasurer, J. T. Collins, Manchester, Me.; directors, as above named and E. E. Emery and M. F. Collins, Manchester, Me., and N. Collins, of West Gardiner, Me.

MOUNDSVILLE, W. VA.—Mercer Electric Railway Company. To build an electric railroad from Bluefield to Athens, both in the county of Mercer. $10,000. Incorporators: James Scott, W. C. Hedrick, J. E. T. Sentz, G. P. Damewood, T. H. Holt, of Princeton, W. Va.

LITTLE ROCK, ARK.—The Mount Mena Traction Company, to construct an electric line from Rich Hill on the Kansas City Southern, to Mount Mena, reaching an altitude of 3,000 feet. $50,000. Officers: Alfred Bissell, president; James L. Hale, secretary and treasurer.

DECATUR, ILL.—Bloomington, Clinton & Decatur Electric Railroad Company, to be constructed from Bloomington to Clinton and Decatur. $50,000. Incorporators and first board of directors: W. R. Carle, Wapella; Harry Schlaudman, Decatur; L. R. Murphy, Clinton; T. N. Leavitt, Maroa; H. W. Knight, Kansas City, Mo.

ENGINEERING SOCIETIES.

THE FARADAY SOCIETY—The Faraday Society will publish its own proceedings, beginning with November. Heretofore the proceedings of this society—which is the association devoted to the interests of electrochemistry and electrometallurgy in England—have been incorporated in the *Electrochemist and Metallurgist.* The new publications will consist of quarterly transactions and monthly proceedings.

NEW YORK ELECTRICAL SOCIETY—The constitution and by-laws and list of life members of the New York Electrical Society, revised and amended for 1904, has been issued. The New York Electrical Society was organized February 23, 1881. Regular monthly meetings are held, at which time valuable papers are presented for reading and discussion. The officers for the seasons of 1904-1905 are Frank J. Sprague, president; C. G. Young, E. H. Mullin, F. C. Bates, Albert F. Ganz, Louis B. Marks and W. S. Rugg, vice-presidents; George H. Guy, secretary; H. A. Sinclair, treasurer.

SOCIETE DES INGENIEURS CIVILS DE FRANCE—The July and August numbers of the *Memoires de la Societe des Ingenieurs Civils de France* contain several interesting papers. M. L. Ribout discusses the regulation of hydraulic turbines, and M. L. Guillet the properties, classification and utilization of special steels. These papers are in the July number. In the August number there are two descriptions of excursions made by the society, and a brief paper upon the equipment of the coal mines of Marles, which are lighted electrically and employ electric traction, telephones and electrically driven ventilators.

PUBLICATIONS.

COMMERCIAL RELATIONS OF THE UNITED STATES—Vol. i of the review of the world's commerce, issued by the Bureau of Commerce and Labor, Washington, D. C., is a compilation of a large number of consular reports made during the past year, covering the relations of this country with all the countries of the world. Such of these as are interesting to the electrical trades have already been noted.

"THE ELECTRIC CITY"—The October issue of "The Electric City," published monthly by the Electric City Publishing Company for the Chicago Edison Company, contains a great deal of interesting matter concerning the electrical and other features at the World's Fair, St. Louis. This issue is, in fact, an illustrated World's Fair number. In addition to the World's Fair material, however, there is considerable literature concerning the uses of electricity in other directions.

THE BULLETIN OF THE NEW YORK EDISON COMPANY—The bulletin of the New York Edison Company for October, 1904, contains, in addition to the editorial paragraphs, a number of interesting descriptions of electrical lighting effects, the current for which is being furnished by the Edison company. A notable illustration is that of the million dollar banking room established by the National Park Bank, Broadway, New York city. In addition to the engineering literature, there is a reproduction in colors of the large group photograph of the members of the International Electrical Congress.

EDUCATIONAL NOTE.

"THE IOWA ENGINEER"—*The Iowa Engineer*, a quarterly publication issued by the engineering departments of the Iowa State College, Ames, Iowa, contains for September an article entitled "Tests of Steam Pipe Coverings," by H. T. Borsheim and L. C. Moody. These tests were presented as a thesis in mechanical engineering at the Iowa State College. The writers graduated with the class of 1904. The object of these tests of pipe coverings was to obtain data in regard to their relative non-conducting values at varying steam pressures. The condensation method was used. The results are made up in several tables, giving the name of the non-conducting material used, with the observations in detail, together with the conditions under which the tests were made. Another article is entitled "Mine Surveying Methods." This article is by L. E. Young, and is continued from the June number. The physical conditions are carefully studied, and there is a rather complete bibliography and reference sheet. In addition to the text there is a series of problems, suggested in order to teach the student graphical and trigonometrical methods for solving mine surveying problems. This is an extremely valuable paper, and ought to prove a great help to the mining engineer student.

ELECTRICAL SECURITIES.

The high level maintained by the stock market for the past two weeks, even despite what would ordinarily cause a severe break, is not being looked upon with the easiness which generally characterizes a strong market. It is feared in many quarters that the apparent high value placed on securities is rather the result of inflation and manipulation than an evidence of absolute worth. While this feeling prevails to a large extent, the general developments of the week have been largely favorable and provocative of continued faith in the bull movement. Improvement in railroad earnings is reported, and there appears to be a solid basis for the statement that the outlook indicates a general increase in railroad dividends in the future, as against the early year fears of reduction in profits. The week has been marked by further improvement in the iron and steel, the copper and coal industries, as well as in many minor directions, notably that of the railroad equipment and finished steel trades.

In discussing the probable condition of affairs for the next six months, it appears to be the consensus of opinion that large manufacturers are marking time until the election will have been definitely settled. There is not so much fear as to the outcome of the campaign, and it is felt that the country is invested with such inherent stability that even although a political change should take place, the many commercial elements depending upon the tariff and the money standard will not suffer to any appreciable extent. As one large manufacturer put it: "there are fewer men in our shops just now than there have been in some time. It is probable that there will be fewer before there are more, but there is every evidence at hand that the enormous amount of money which had been piled up during the boom of two years ago, and which was subsequently held up through a natural timidity, will soon be released. A great deal of work has, of course, first to go through the engineering department. It may be some time before it will reach the shops, but the work is here. It has to be done, and there is every reason to believe that we will witness even greater expansions of manufacture than we have yet known."

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 29.

New York:	*Closing.*
Brooklyn Rapid Transit	67⅝
Consolidated Gas	216¾
General Electric	176½
Interborough Rapid Transit	159½
Kings County Electric	195
Manhattan Elevated	163¾
Metropolitan Street Railway	124
New York & New Jersey Telephone	156
Westinghouse Manufacturing Company	190

The Westinghouse Electric and Manufacturing Company has announced that it will issue $15,000,000 twenty-year five per cent debenture bonds, redeemable on call at 105 and interest. It is denied that there is any intention to retire the first preferred stock or outstanding debentures by first mortgage bonds. It is thought that the new debentures will be used in taking up outstanding issues.

Boston:	*Closing.*
American Telephone and Telegraph	144
Edison Electric Illuminating	250
Massachusetts Electric	55
New England Telephone	135
West Telephone and Telegraph preferred	95

The directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of $1.50 per share, payable November 15.

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	72
Electric Storage Battery preferred	72
Philadelphia Electric	9
Union Traction	57
United Gas Improvement	103¾

Chicago:	*Closing.*
Chicago Telephone	140
Chicago Edison Light	160
Metropolitan Elevated preferred	66½
National Carbon common	35½
National Carbon preferred	109
Union Traction common	8⅞
Union Traction preferred	34

National Carbon directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable November 15. Books close November 5 and reopen November 16.

ELECTRIC LIGHTING.

BUENA VISTA, CAL.—An electric light plant has been installed at St. Elmo.

DRYDEN, N. Y.—The Groton Bridge Company is installing an electric plant.

YORK, PA.—At a special election it was decided to install an electric light plant.

WEST POINT, IOWA—Work has been commenced on the city's electric light plant.

LITTLE ROCK, ARK.—An electric light plant will be established at Foreman.

GENEVA, NEB.—Work has been commenced on the Skinkle electric light plant.

PANAMA, N. Y.—A company has been formed to install electric lights in the village.

LENOX, IOWA—The Lenox Electric Light and Power Company has been granted a local franchise.

MOUNT CARMEL, PA.—Work has been started on an electric light plant for the Locust Gap mines.

CLARKS, NEB.—The Clarks Electric Light Company has rebuilt its plant, which was recently destroyed by fire.

SUMNER, IOWA—Hartig & Heller, of Minneapolis, have been granted a franchise for an electric light and power plant.

AMORY, MISS.—The Amory Light and Power Company will install an electric lignt plant, to be completed by January 1.

MILWAUKEE, WIS.—Cameron is considering the question of building an electric light plant in connection with the waterworks system.

BUTTE, MONT.—Harry W. Turner and Max Hebgen, of this city, have purchased from Eric V. Haser, of St. Paul, the Havre electric light plant.

BONNER SPRINGS, KAN.—The Kaw Valley Telephone and Electric Light Company will shortly build an addition to its light plant in this city.

SILVER CITY, MISS.—The citizens of Silver City have organized a company known as the Citizens' Electric Light, Water and Manufacturing Company.

BELLAIRE, OHIO—The Bellaire Light and Power Company has completed improvements to its plant which cost in the neighborhood of $75,000.

SAULT STE. MARIE, MICH.—The Edison Sault Electric Company has completed additions to the plant which will materially improve the service.

GREAT FALLS, MONT.—An electric lighting circuit is being installed between Belleco and the Sunnyside mine. The power plant will be located at Belleco.

VANCOUVER, WASH.—Electric lights have been installed at Vancouver Barracks. The power is furnished by the Vancouver Electric Light and Power Company.

PITTSBURG, PA.—Work has been started on the erection of the Allegheny City light plant. The contract was recently awarded to C. F. Knapp, at a cost of $33,472.

ABERDEEN, MD.—The question of bonding the town of Aberdeen for $8,000, for the purpose of installing an electric light plant, was carried at a recent election.

ONEIDA, N. Y.—The project of building an electric power plant at Limekiln falls is said to be well under way. J. George Kaelber and Richard Doyle, of Rochester, are interested.

NEW HOPE, N. J.—An ordinance has been passed granting permission to the Lambertville Heat, Light and Power Company to erect its poles and wires within the town limits.

PETERSBURG, VA.—It is stated that a new electric light company will be formed. The company will not only become a bidder for the city lighting, but will furnish light and power for private use.

SHENANDOAH, IOWA—The Electric Light and Power Company has passed into the hands of the new Shenandoah Artificial Ice, Power, Heat and Light Company, of which John J. Dunnegan is president.

BURLINGTON, VT.—The contract for the new municipal electric light plant has been awarded and work will commence at once. The plant will probably be furnishing light to the city by next February.

HAZEN, ARK.—The city council has granted a franchise to the Hazen Electric Light and Telephone Company to put in an electric light plant. The company is composed of E. K. Hathaway, T. P. Young and others.

BELLOWS FALLS, VT.—The Fall Mountain Electric Light and Power Company is extending its lines to Alstead, N. H. The company already has lines running to Walpole, N. H., and to Westminster and Saxtons river.

FAIRMOUNT, IND.—The Larue & Patterson electric light plant has been sold to Francis M. Ingler, of Indianapolis. Mr. Ingler will expend $20,000 at once in installing modern machinery and bringing the plant up to date.

SEDALIA, MO.—The United Water, Light, Gas and Electric Company has purchased a tract of land west of its present plant, and will erect thereon a large power-house. It is stated that work will commence within sixty days.

LARAMIE, WYO.—A. T. Holmes and Charles F. Kuster, of Laramie, and H. D. McCutcheon, of Pittsburg, are behind a company which will install an electric light plant in this city. A franchise has already been secured.

FLORENCE, COL.—The Colorado Electric Power Company is constructing a new line to the Radiant coal mine, seven miles south of this city. It will go by the way of Rockvale, following the Santa Fe spur now being built.

ELMIRA, N. Y.—At a meeting of the board of trustees of Horseheads, the Elmira Water, Light and Railroad Company was given a franchise for five years to furnish thirty-four arc lights for the village. The price paid is $60 per lamp per year, each lamp to be run from sundown until 1 A. M. during the entire year.

SHERMAN, TEX.—The Sherman Gas and Electric Company has filed with the county clerk a deed of trust in favor of the St. Louis Union Trust Company for the sum of $100,000. It is stated by local representatives of the company that part of the funds thus secured will be used immediately for improvements in Sherman.

WILMINGTON, DEL.—At a special meeting of the city council a resolution was passed granting to the Delaware Water Improvement Company the exclusive right to the streets of this city for the laying of water mains, erecting electric light poles and stringing wires for electric lighting and heating for a period of twenty-five years.

GOUVERNEUR, N. Y.—The St. Lawrence River Power Company, of Massena, purposes constructing a power line to parallel the Rome, Watertown & Ogdensburg Railroad from Massena to Gouverneur, using steel poles. It is estimated that the work will cost $500,000. Work will be begun next spring, provided the company can make contracts for 3,000 horse-power.

WORCESTER, MASS.—At the annual meeting of the Worcester Electric Light Company the officers were reelected, as follows: president, A. B. R. Sprague; treasurer and secretary, Herbert H. Fairbanks; superintendent, William H. Cough; directors: Stephen Salisbury, Theodore C. Bates, Loring Coes, A. B. R. Sprague, Josiah Pickett, George T. Dewey and Otis E. Putnam.

NEW ORLEANS, LA.—The preliminary work in connection with the new lighting plant to be installed in this city has been commenced. Two thousand seven hundred lights are to be installed, and the contract between the city and the New Orleans Light and Power Company calls for the completion of the work by December 1, 1905. Part of the wiring will be placed underground.

WELDON, N. C.—At the annual meeting of the Roanoke Rapids Power Company the following officers were elected: W. M. Hablis-

ton, of Richmond, president; R. M. Chanler, of New York, vice-president; Winthrop Chanler, of New York, treasurer; H. V. N. Phillips, of New York, assistant treasurer; James M. Mullin, of Petersburg, secretary.

WINONA, MINN.—The city council has granted Henry M. Lamberton the right to construct and maintain poles, wires, etc., in the city of Winona, for the purpose of furnishing electricity for light, heat and power. The franchise is to run for twenty-five years. It is understood that Mr. Lamberton is interested in the proposed development of water power at Minnesota City.

APPLETON, WIS.—Thomas Rockwell, of Oshkosh, has announced the consolidation of the Negaunee (Mich.) Gas Company and the Negaunee & Ishpeming Gas and Electric Company. Mr. Rockwell will be president of the new company, and Edgar B. Finch secretary. Both of these officials were formerly connected with the Fox River Valley Gas and Electric Company, which was recently purchased by the Wisconsin Traction, Heat, Light and Power Company.

NIAGARA FALLS, N. Y.—The board of directors of the Suburban Power Company has elected the following officers: D. O. Mills, president; William B. Rankine, first vice-president; Nathaniel Rochester, second vice-president; DeLancey Rankine, secretary, treasurer and general manager. Executive committee: William B. Rankine, Edward A. Wickes and George W. Davenport. Counsel, Harold Sturgess Rankine. The company was incorporated October 11 for the purpose of distributing power only.

INDIANAPOLIS, IND.—The Merchants' Heat and Light Company has leased the first two floors of the Richards Building, in West Pearl street, for a substation for supplying electric light and power for the business district of the city. Two 1,000-horse-power converters are being put in on the ground floor. The company will use the second floor for shops. The ground floor of the building has been made as near fireproof as possible by rebuilding the first floor with steel girders and cement, so that a serious fire in the upper floors of the building would not injure the working of the machinery and switchboards. The machinery for the substation cost about $35,000, and improvements on the building have been made for about $5,000.

ELECTRIC RAILWAYS.

AUSTIN, TEX.—The Austin Electric Railway Company has filed a deed of trust for $350,000.

APOLLO, PA.—Work has been started on the new trolley line between Apollo and Leechburg.

EVANSVILLE, IND.—The city council has granted a franchise to the Evansville & Eastern Electric Railway.

GUTHRIE, OKLA.—John Shartel, of Oklahoma City, will build an interurban line between this city and Oklahoma City.

DANVILLE, VA.—The Danville Street Railway and Electric Company will build an extension to Schoolfield. John F. Rison is vice-president of the road.

FORT WORTH, TEX.—The Northern Texas Traction Company is now engaged in making improvements, the aggregate cost of which will reach more than $50,000.

BAY CITY, MICH.—The Detroit, Pontiac, Lapeer & Northern Electric Railroad Company has been changed to the Detroit & Bay City Traction Company.

SHERMAN, TEX.—It is stated that there is a movement under way to build an electric railway from Sherman *via* Cannon to connect with the proposed line that is to be built between McKinney and Bonham.

ALLENDALE, MICH.—The people of Allendale are reported to be very desirous of securing an electric railway. Such a road would reach Jenison, Bauer, Pearline, Conger, Allendale, Bass River, Robinson and Peach Plains.

PARKESBURG, PA.—An ordinance has been passed by the borough council granting to the Parkesburg & Oxford Trolley Company the right to enter the borough. The road will be fourteen miles in length and is to be complete in twelve months.

PONTIAC, MICH.—The Detroit & Bay City Traction Company has asked for a franchise for a proposed electric freight and passenger railroad from Detroit to Bay City, taking in the towns of Franklin, Pontiac, Lapeer, Mayville, Caro, Akron and Bay City.

COLFAX, WASH.—The contract for grading on the Whitman electric line has been let to J. M. Bodine, of Elberton. Work will be begun at a point on Spring flat, just outside of the city limits. The road will run from Colfax to Palouse, *via* Spring flat and Albion.

MADISON, WIS.—Lake Superior & Southeastern Railway Company has been incorporated to build a line from Superior to Marshfield, about 100 miles, through the counties of Douglass, Washburn, Bayfield, Sawyer, Barron, Chippewa, Gates, Taylor, Clark, Marathon and Wood.

CLEVELAND, OHIO—The village of Cleveland Heights has concluded a deal with the Cleveland Electric Railway Company by which the company gets a franchise on Mayfield road. The railway company intends to extend its present Euclid Heights line out to Mayfield road.

INDEPENDENCE, ORE.—Papers incorporating the Independence & Salem Electric Railway Company have been drawn up. The incorporators are J. M. Stark, D. Calbreath and C. L. Fitchard. The purpose is to build an electric line connecting Salem and Independence.

CONNERSVILLE, IND.—The county commissioners have granted the Columbus, Greensburg & Richmond Traction Company an extension of the franchise through Fayette County. The old franchise expires December 31. The company expects to begin construction work next season.

BENTON HARBOR, MICH.—The city council has granted J. B. McMichael a franchise for the independent entry and terminal facilities for his interurban line which is to connect this city with Eau Claire, Niles and Dowagaic. It is expected that grading will be completed before spring.

DAVENPORT, WASH.—A large corps of surveyors is at work north of Davenport upon one of the new electric railroads which is being promoted by Spokane and eastern men. The preliminary survey is now about completed from Fort Spokane, or Crystal City, on the Spokane river, as far as Davenport.

PORT ANGELES, WASH.—All the property and franchises of the Port Angeles Eastern Railroad have been transferred to the British-American Finance Company for a consideration of $800,000. The company states that it will build a road to Olympia in one year, and that its objective point is Portland, Ore.

KALAMAZOO, MICH.—The name of the electric railroad which will run from this city to Grand Rapids has been changed from the Grand Rapids & Chicago Railway Company to the Grand Rapids & Kalamazoo Valley Railway Company. It is stated that the road has been financed, and that work will commence shortly.

PITTSBURG, PA.—The Pittsburg, Etna & Butler Street Railway Company has secured a route for the entrance of a trolley line into this place from Pittsburg. The work of grading and laying track is not to be commenced until next spring. For a large part of the distance, between Thorn creek and Butler, six miles, the trolley line nearly parallels the Pittsburg, Bessemer & Lake Erie Railroad.

WAPAKONETA, OHIO—Work on the Sandusky Southwestern electric line has been commenced. The proposed route is as follows: one line to run from Bellefontaine to Lima, another from this city *via* Roundhead to Kenton, and another *via* Ada and Algers to Kenton. The contract for the grading of the line has been let to the Blodgett-Coon Company, and it has guaranteed to have the grading done by the first of January.

SOUTH BETHLEHEM, PA.—The Newtown & Hatboro Railway Company and the Willow Grove & Richboro Street Railway Company have been organized with the following officers: president, C. N. Bates, Allentown, Pa.; directors, John G. Honecker, Yardley; Martin V. Dager, New Hope; Horace G. Reeder, Newtown, and C. M. Walter and V. D. Bates, Allentown. The route of the Newtown & Hatboro Street Railway will lie directly across Bucks County, from Newtown

to Richboro, to Jacksonville, Ivyland and Hatboro. The Willow Grove & Richboro Street Railway follows the Second street pike from Richboro to Davisville and Willow Grove.

CORVALLIS, ORE.—An ordinance granting a franchise to the Willamette Valley Electric Railway Company to operate a line through Corvallis has been passed by the city council. This is the proposed line connecting with Eugene, *via* Monroe and other southern Benton County points. The ordinance provides acceptance of the conditions of the franchise within ninety days and completion of the road within twenty-four months after.

TOLEDO, OHIO—It is announced that the Lake Shore & Michigan Southern Railway Company is to buy the holdings of the Lake Shore Electric Company running trolley cars from Toledo to Cleveland, and also the new and not yet completed Port Clinton, Lakeside & Toledo electric line. It is said that the Lake Shore will use the old road for freight purposes and fully equip the new lines for passenger traffic exclusively.

MAYSVILLE, KY.—A new traction line is to be built from this city to Germantown *via* Washington, opening up the richest section of Mason County. Evan Lloyd, of Germantown; John Duley, C. L. Sallee and Thomas A. Davis, of this city, are interested in the project. The line will tap the Chesapeake & Ohio at Brooksville, and from Washington it will run through Mayslick and Sardis to Mt. Olivet, in Robertson County.

JACKSON, MISS.—Three miles of electric railroad is to be built at Greenwood at once, the preliminary survey being now in progress. German capitalists have been interested in the matter and it is stated that they will join with local capitalists in constructing a line from Greenwood to Black Hawk and to Itta Bena, thus bringing a large amount of trade to the latter town from new sections.

CHAMPAIGN, ILL.—The McKinley syndicate is to build a branch traction line from Oakwood to Catlin. The road will be known as the Catlin & Northern and will be constructed principally to tap the Catlin and Oakwood coal fields. The incorporators of the company named in the certificate of incorporation are: L. E. Fischer, George T. Buckingham, W. Y. Dysert, Robert Parks and George Fisher, all of Danville.

GREENSBURG, PA.—A permanent organization of the Jeannette, West Newton & Monongahela Street Railway Company has been effected by the election of the following officers: president, J. C. Cribbs; vice-president, W. H. Van Valin; treasurer, W. F. Euwer; secretary, A. T. Smith; directors, J. N. Bowman, W. A. Cribbs, N. J. Baxter, Frank Barnhart, D. W. Jenkins, J. C. Cribbs, W. H. Van Valin and A. T. Smith.

POTTSVILLE, PA.—The newly chartered Oxford, Cochranville & Parkersburg Electric Railway Company has decided to issue bonds in a sum not exceeding $300,000. The southern terminus of this road is to be in Oxford. It will extend through the villages of Hayesville, Russellville and Cochranville and the township of Lower and Upper Oxford, West Fallowfield and Highland, to Parkersburg, a distance of about fourteen miles.

SYRACUSE, N. Y.—The Auburn & Northern Electric Railroad Company, which will build a line from the prison city to Port Byron, has asked the common council of that city for a franchise to build a belt line in the principal business part of that town, and if the franchise is granted this company, in conjunction with the Auburn & Syracuse and the Auburn City Railway companies, will build a union passenger and freight depot.

MODESTO, CAL.—Capital has been subscribed and a route surveyed for a new electric trolley line from Modesto to Riverbank, a station on the Santa Fe road, to connect at Riverbank with the new Santa Fe branch line now building to Oakdale. The Santa Fe's branch from Riverbank will connect at Oakdale with the Sierra Railroad. The electric line will furnish a direct route from Modesto, the county seat, to the eastern section of the county.

LOS ANGELES, CAL.—H. E. Huntington has acquired control of five miles of ocean front property lying mostly in Orange County and including practically all of the bay front at Newport. The Pacific electric line which now runs to Huntington Beach is to be extended to Newport Beach, making nine miles of new track. The company also intends to run a line eleven miles long from Newport to Santa Ana. Work on the new lines will begin at once.

LANCASTER, OHIO—Eli Rowles, who some time ago secured the right of way for an electric road from Lancaster to Newark, by way of Pleasantville and Millersport, has succeeded in interesting the Tucker-Anthony syndicate in the enterprise, and it is said the road will be financed by that company. Part of the right of way is along the high roads in this county and was granted by the county commissioners, who have also extended the life of the franchise.

FORT SMITH, ARK.—It is stated that the Commercial Club, of Fort Smith, has taken up a proposition from the promoters of the Fort Smith, Indian Territory & Texas road, asking for a bonus of $40,000 with which to purchase terminals. It is proposed to build the road from Coal Creek, twenty-five miles out of Fort Smith, to Wilburton, a distance of about fifty miles, the line to come into Fort Smith from Coal Creek over one of the lines, probably the Fort Smith & Western.

UTICA, N. Y.—The property owners of Washington Mills, Willowvale and Chadwicks are discussing the matter of an electric line through the Sauquoit valley. A committee composed of M. F. Jordan, of Chadwicks; Delos Terry, of Washington Mills, and J. McManus, W. N. Lambert, A. U. Jones and John Chadwick, of Chadwicks, has been appointed to investigate the matter, confer with the town board as to franchises, and attend to other business. Electricity for lighting and other purposes is also wanted in the valley.

HAGERSTOWN, IND.—Charles Mikels, of Newcastle, promoting the new interurban line between Richmond and Newcastle, has obtained several tracts of land in this vicinity that were necessary to complete the right of way for the proposed line. The right of way is now practically continuous between Richmond and Newcastle, paralleling the Pan-Handle Railroad all the way. It is expected that the sixteen miles of road between this city and Richmond will yield a very heavy traffic to the new electric road.

SYRACUSE, N. Y.—One of the largest power-houses in New York state will be built near Lyons by the Rochester, Syracuse & Eastern Railroad Company to generate power for its electric road between Rochester and this city. It will cost approximately $250,000, and as at first built will generate 5,000 horse-power. This will be more than enough to operate the first section of the road, which will be in operation between Rochester and Lyons by January 1, 1906. When the remainder of the line is built another unit will be added which will increase the capacity to 7,000 horse-power. This will be sufficient to operate the eighty miles of double-track road.

BOSTON, MASS.—Residents of Hanover, Norwell and Scituate intend to build a trolley line from the terminus of the old Colony street railway line, at Assinippi, to Norwell Centre and Scituate, a distance of about eight miles. Charles H. Killam, of Hanover, who was president of the old Hanover street railway, and C. L. Stevens, of Rockland, a director in the same company, have made arrangements with the Old Colony Street Railway Company to secure power, and it is expected that the money for the project will be raised along the line of the road. The road will open up new country, giving the people along the South Shore direct access to the interior of Plymouth County towns.

BROOKLYN, N. Y.—Ground has been broken by the New York & Long Island Traction Company within the territory of the city of New York, near Rosedale, for the extension of its Mineola, Hempstead, Freeport and Rockville Centre trolley line from Nassau into Queens County. Work will be pushed rapidly on the extension which will proceed on a route north of and parallel to the Brooklyn waterworks conduit and over private property to a point where it intersects the Rockaway turnpike and over that highway to Broadway. It will traverse Broadway, through Woodhaven, to the Brooklyn line, where it will connect with the Kings County Elevated Railroad. This company has already built nearly forty miles of trolley lines in Nassau County, including a line from Queens to Hempstead; a line from Mineola to Freeport to the Queens County line. The extension through Queens above described will give a close connection between the forty miles of railroad in Nassau County and all the Brooklyn Rapid Transit lines in Brooklyn borough.

PERSONAL MENTION.

MR. D. R. HANNA has been elected to the directorate of the Cleveland Electric Railway Company, vice George G. Mulhern, resigned.

MR. LOUIS H. JACOBI, JR., formerly general agent of the Sunset Telephone Company, at Oakland, Cal., has been appointed district manager for Alameda County, succeeding E. J. Willis.

MR. EDWIN E. DOWNS, president and general manager of the Winnebago Traction Company, has tendered his resignation and will leave Oshkosh as soon as his successor has been decided upon.

MR. J. F. O'DONNELL, manager of the Postal Telegraph-Cable Company, at Sherman, Tex., has been appointed superintendent at Joplin, Mo. He will be succeeded at Sherman by P. R. Napier, of Hillsboro, Tex.

MR. EVAN D. HUBBARD has been appointed superintendent of the electrical lines of the Grand Trunk Railway, with headquarters at Battle Creek, Mich. He will have charge of all telephone and telegraph wires and signal appliances.

MR. H. DURANT CHEEVER, of the Okonite Company, New York city, returned last week from the Maine woods where, with Mrs. Cheever, he spend several weeks hunting big game. The largest moose secured by the party was shot by Mrs. Cheever.

MR. JAMES F. FAIRMAN, telephone engineer, who was recently associated with Waterbury & Company, New York city, is now associated with the Ericcson Telephone Company, New York, N. Y. Mr. Fairman will look after the business end of this company for the eastern territory.

MR. GEORGE HILLMAN WHITFIELD, electrical and mechanical engineer for the Virginia Passenger and Power Company, Richmond, Va., was married recently to Miss Laura Merryman Crane, of Baltimore, Md. The ceremony took place at the Eutaw Place Baptist Church, Baltimore.

MR. H. M. SMITH, formerly train despatcher of the Lake Shore Electric Railway, has been appointed general manager of the Rockford & Interurban Electric Railway, of Rockford, Ill. Mr. Smith was train despatcher for the Lake Shore road for the last five years, making his headquarters at Fremont, Ohio.

MR. F. G. JONES, president of the American Electric Fuse Company, Chicago, Ill., recently returned from a trip to the eastern office of the company at New York city. The American Electric Fuse Company's eastern department headquarters are at 110-116 Nassau street. Mr. Jones reports that the company's New York office has recently concluded contracts for over 20,000 pairs of Kaisling protectors, and that the eastern business has more than doubled since last year. This result is due to the energetic work of W. B. McCurdy, eastern manager of the company. Mr McCurdy is well and favorably known throughout the entire East. Mr. Jones also reports that the company's sales of protectors during the month of October at all its offices have been in excess of 35,000 pairs, and that proposals are under way now for over 100,000 pairs of Kaisling protectors. The company feels certain that it will secure all of these orders.

OBITUARY NOTICES.

MR. J. SEWELL THOMAS, JR., died on the morning of October 25 at his home in Baltimore, Md. Mr. Thomas was about twenty-six years old, and had been employed during the past two years as a clerk by the municipal electrical commission under Subway Engineer Phelps. Mr. Thomas was a son of the deputy city register of Baltimore.

MR. BERTRAND B. ABRY died on the morning of October 31, at Pittsburg, Pa. Mr. Abry was a student at the University of Nebraska, and graduated from the University of Illinois in 1900 with the degree of bachelor of science in electrical engineering. After his graduation he went to the works of the Westinghouse Electric and Manufacturing Company, going through the various shops, and was at the time of his death holding an important position in the railway department. Mr. Abry will be remembered as the author of an excellent series of articles in this journal on "Shop Testing of Motors and Generators for Commercial Service." Mr. Abry had rapidly forged to the front as a practising engineer of considerable ability, and was surely marked out for a career of great usefulness. His death will be mourned by an exceptionally large circle of friends and acquaintances, both professional and otherwise. His remains were conveyed to Cheyenne, Wyo., where the interment took place later in the week.

MRS. HELEN E. BLITZ, president of the Bishop Gutta-Percha Company, died at her residence in Westfield, N. J., on Saturday, October 22. Mrs. Blitz was the widow of Signor Antonio Blitz, a celebrated ventriloquist. Signor Blitz was a great favorite in all parts of the country for thirty years or more prior to 1870. About that time he retired to Philadelphia and spent his remaining years, which ended in 1876, in exhibitions for various charities in that city. Upon the death of her husband Mrs. Blitz came to New York and made her home with Mrs. S. C. Bishop, a cousin and an intimate friend. Mrs. Blitz's maiden name was Eaton, and her mother's name was Adams, both parents being of noted Boston families. Mr. Samuel C. Bishop had died four years prior to the death of Mr. Blitz, leaving the care of his estate to his widow, who, being in poor health, was fortunate in having the assistance of Mrs. Blitz, who was obliged to take upon herself the conducting of these affairs. Upon the death of Mrs. Bishop in 1881, Mrs. Blitz, by the collateral wills of Mr. and Mrs. Bishop, who had no direct heirs, inherited one-quarter of their estate, including the Bishop Gutta-Percha Works, and upon the organization of the present Bishop Gutta-Percha Company was elected a director. She became its president in 1894, and held that office until her demise. Mrs. Blitz had recently been making arrangements for a beautiful residence at Westfield, N. J., and it was while watching some of the final work of the decorator that she was stricken with apoplexy. She was cremated at Fresh Pond Crematory, on Tuesday, October 25, following the direction incorporated in her will.

MR. MAX OSTERBERG, the well-known consulting electrical engineer and expert, died at his home at Brighton Heights, Staten Island, on Wednesday, October 26. Mr. Osterberg suffered an apoplectic stroke during the middle of July, and a second stroke resulted in his death. Mr. Osterberg was born on June 12, 1869, at Frankfurt-on-the-Main, Germany. He was the son of Henry Osterberg, a manufacturer and financier, who possessed a character of rigid integrity and high principles. Young Osterberg received his primary education in the Realschule, of his place of birth, came to America when sixteen years of age, and soon after his arrival found employment as an office boy in a large manufacturing house, where he remained until his twenty-second year, having in the meantime not only secured advancement to the position of bookkeeper and general manager, but had qualified himself for entrance to Columbia University, New York, from which, after an attendance of only two years, he was graduated with high honors and the degree of E. E. From 1894 to 1896, Mr. Osterberg made a special study of Hertzian waves and wrote a work on thermodynamics, which became a textbook in many leading colleges in this country, including Columbia. He was awarded an honorary fellowship, and in 1896 received from Columbia the degree of A. M. During the Chicago World's Fair, Mr. Osterberg was editor of the *Proceedings of the Electrical Congress*. He was editor of *Electrical Power* until 1896, and was associated at that time with T. A. Edison on his X-ray investigations, being the fourth man on record in this country to obtain a satisfactory picture, and in X-ray photography he achieved great success. In the fall of 1896 Mr. Osterberg started in business for himself as consulting electrical and mechanical engineer, with offices at 11 Broadway. He was a member and former vice-president of the New York Electrical Society, a member of the American Institute of Electrical Engineers, the American Mathematical Society, the American Electrochemical Society and an honorary member of the National Society of Electrotherapeutics. Mr. Osterberg was also a member of several charitable and social organizations and a director in a number of industrial companies.

INDUSTRIAL ITEMS.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in bulletin No. 68 describes and illustrates its single-phase, alternating-current power motors. This bulletin, in addition to half-tone illustrations of the motors, gives diagrams of connections, and will be sent upon request.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, is distributing several bulletins descriptive of telephone apparatus and transmitters and receivers. The Dean transmitter is claimed by the manufacturer to be a device of remarkable simplicity and effectiveness. This literature will be sent upon request.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is distributing a large hanger illustrating a number of different pieces of apparatus. Each of these is indicated by its bulletin number. The hanger is so arranged that ready reference may be made to any particular piece of apparatus.

THE MOLINE INCANDESCENT LAMP COMPANY, Moline, Ill., has opened a branch office at 105 Chambers street, New York city, with E. E. Anderson as manager. A branch office has also been opened in New Orleans, with S. J. Stewart as manager. Other offices will be opened as rapidly as proper representatives can be secured.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., and San Francisco, Cal., is advocating the contract method of buying lamps. The lamp season is now at its height, and an unusully heavy fall business, the company says, is being handled with ease and promptness, owing to the large number of customers taking advantage of this system.

ROSSITER, MacGOVERN & COMPANY, INCORPORATED, 17 Battery Place, New York city, has issued an attractive booklet giving a list of electrical and mechanical apparatus ready for immediate shipment. This company maintains, both in Jersey City and at St. Louis, extensive repair shops, where it is prepared to execute promptly all kinds of electrical repair work.

THE ELECTRIC MOTOR AND EQUIPMENT COMPANY, Newark, N. J., is calling attention to various forms of electric advertising signs which it has successfully installed. This remarkably attractive catalogue shows numerous typical decorative schemes, and reflects much credit upon the company. The book is well worth securing for the variety of ideas which it presents.

JAMES S. BARRON & COMPANY, New York city, announce that the sales of their H.-P. rustless hangers are increasing very rapidly. Several large telephone and telegraph companies have adopted this hanger, and a still greater demand is anticipated. The company will be pleased to send descriptive literature concerning this device and other specialties for telephone and telegraph work.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., is distributing, in handsome form, the paper and discussion presented at the twentieth annual convention of the American Institute of Electrical Engineers, at Niagara Falls, N. Y., June 29, on "Commercial Alternator Design," by W. L. Waters. This paper is illustrated by a number of fine diagrams and half-tone reproductions.

THE BOSSERT ELECTRICAL CONSTRUCTION COMPANY, Utica, N. Y., is fitting up the government laboratory at Manila with eight Bossert distributing panel-boards and one switchboard. This company has made decided strides in the production of panel-boards, switchboards and junction boxes. Increased economy and efficiency are effected by the improvements which the company has introduced in its apparatus.

THE SAFETY-ARMORITE CONDUIT COMPANY, Frick Building, Pittsburg, Pa., announces that it has entered suit against Cortlandt D. Richmondt and the Mark Manufacturing Company, Chicago, Ill., doing business at Evanston, Ill., and Zanesville, Ohio, in the United States Circuit Court for the Northern District of Illinois, asking for an injunction restraining the defendants from engaging in the manufacture or sale of electric iron-armored conduit.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 529 West Thirty-fourth street, New York city, is distributing a discount sheet and catalogue. This catalogue contains a list of the bulletins which have been issued from time to time by the General Incandescent Arc Light Company, and which are now available. The bulletins are designated by certain numbers, according to their classifications. Any of these bulletins may be obtained upon request.

THE GRAY TELEPHONE PAY STATION COMPANY, Hartford, Ct., is distributing an attractive advertising booklet calling attention to its automatic and registering equipment for public and measured telephone service. This booklet describes and illustrates the various types of apparatus made by the company. Since 1888 over 130,000 of these automatic toll collectors have been placed in operation. The company recommends the use of five-slot automatic machines, but is prepared to furnish to the trade anything which may be required in the way of size, form or number of slots. Most of the styles the company makes are kept in stock and can be shipped without delay.

DODGE & DAY, Philadelphia, Pa., have been commissioned by the Conkling-Armstrong Terra-Cotta Company, makers of architectural terra-cotta, to engineer, rebuild and reequip its plant at Wissahickon and Juniata streets, Philadelphia, which was recently destroyed by fire. Dodge & Day will also install some 400 horse-power in Westinghouse motors, ranging in capacity from five to 150 horse-power, in the new plant of the Victor Talking Machine Company, Camden, N. J. The company is also engineer for the plant of the Janesville Iron Works, of Hazleton, Pa., where an addition of a seventy-five-kilowatt De Laval steam turbine generator is being made to the installation.

THE F. BISSELL COMPANY, Toledo, Ohio, has issued bulletin No. 21, illustrating and describing "Security" panelboards. This bulletin contains complete information, giving full data and prices of twenty-four different styles, ranging in capacity from two to twenty-four circuits. In addition, the bulletin describes and illustrates numerous panelboard boxes and covers, from the plainest to the most expensive types. The switchboard department of the Bissell Company is rapidly becoming one of the most important branches of this supply house. The company's bulletin No. 118 gives full data and prices on some thirty-six different types of switchboard, ranging in capacity from 25 to 3,500 amperes.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a number of bulletins and pamphlets descriptive of various pieces of apparatus. Price lists Nos. 5131 and 5132 give quotations and illustrations concerning Edison miniature incandescent lamps. There is also a supplement to supply catalogue No. 7560, giving parts of various forms of controllers. Flier No. 2143 describes the "Noblac" heat-resisting globe, and flier No. 2145 describes and lists standard cast-iron flange couplings. A very attractive booklet is that describing the transformer for thawing-out purposes. Bulletin No. 4386 describes and illustrates attachments for type C, form M and form K circuit-breakers. Bulletin No. 4388 describes curve-drawing instruments for alternating-current circuits. Bulletin No. 4389 is descriptive of modern long-distance electrical transmissions.

THE CONTINUOUS RAIL JOINT COMPANY OF AMERICA, Newark, N. J., has been awarded a gold medal for rail fastenings for its display in the Transportation Building at the World's Fair. The company's exhibit shows the various types of rail joints produced by patented machinery. The careful manufacture and perfect fit, giving three points of contact in one piece of metal, thus forming a rail joint of two symmetrical pieces, have secured for the company from both steam and electric railroads appreciation of the great value of this device. Over 20,000 miles of railroad track has been equipped with this rail joint in the past ten years. The company owns and operates the Albany Iron and Steel Works, at Troy, N. Y. It has on the market to-day types of joint for T-rails and girder rails that are made of rolled steel. The company also manufactures step or compromise joints to connect rails of different sections and obtain a perfect surface and gauge for abutting rails. These are made of cast steel. The company is now bringing out a new type of insulated rail joint, and also an electric bonding joint which will shortly be placed upon the market. The development of the business has made it necessary to organize a company in Canada for the exclusive use of Canadian patents originally owned by the company, and another corporation in London, England. This appliance has already been introduced in many foreign countries.